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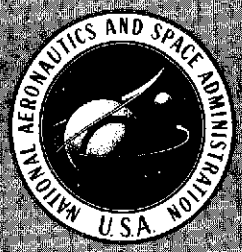

AERONAUTICAL ENGINEERING

A SPECIAL BIBLIOGRAPHY WITH INDEXES

Supplement 50

NOVEMBER 1974

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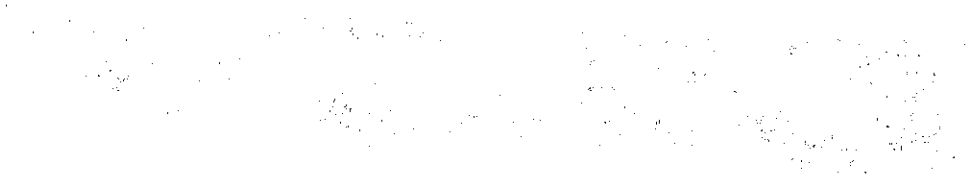

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NASA SP-7037 (50)

AERONAUTICAL ENGINEERING

A Special Bibliography

Supplement 50

A selection of annotated references to unclassified reports and journal articles that were introduced into the NASA scientific and technical information system and announced in October 1974 in

- *Scientific and Technical Aerospace Reports (STAR)*
- *International Aerospace Abstracts (IAA).*

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This supplement to *Aeronautical Engineering—A Special Bibliography* (NASA SP-7037) lists 187 reports, journal articles, and other documents originally announced in October 1974 in *Scientific and Technical Aerospace Reports (STAR)* or in *International Aerospace Abstracts (IAA)*.

The coverage includes documents on the engineering and theoretical aspects of design, construction, evaluation, testing, operation, and performance of aircraft (including aircraft engines) and associated components, equipment, and systems. It also includes research and development in aerodynamics, aeronautics, and ground support equipment for aeronautical vehicles.

Each entry in the bibliography consists of a standard bibliographic citation accompanied in most cases by an abstract. The listing of the entries is arranged in two major sections, *IAA Entries* and *STAR Entries*, in that order. The citations, and abstracts when available, are reproduced exactly as they appeared originally in *IAA* or *STAR*, including the original accession numbers from the respective announcement journals. This procedure, which saves time and money, accounts for the slight variation in citation appearances.

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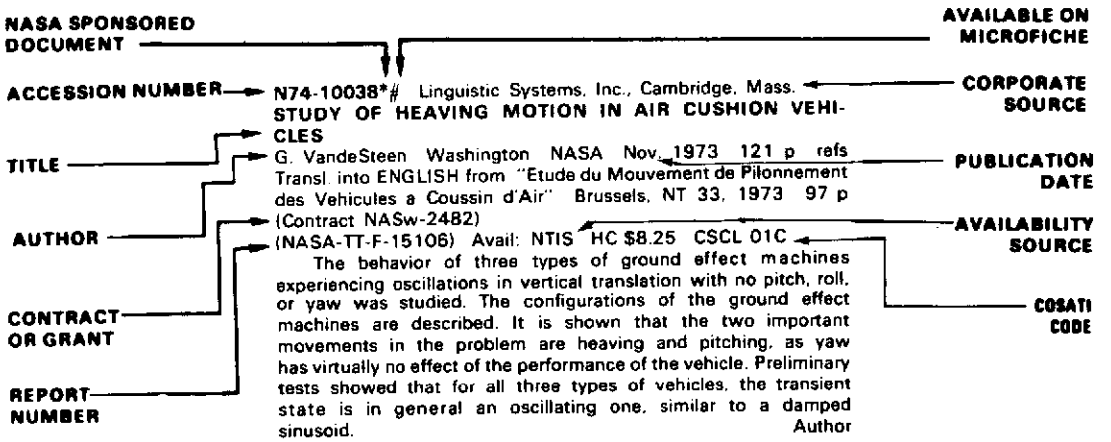

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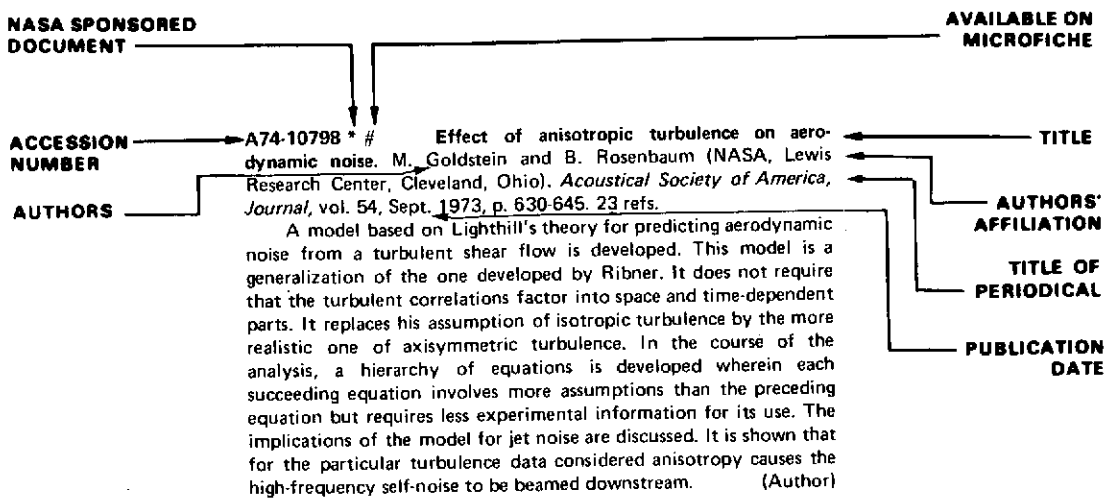

AERONAUTICAL ENGINEERING

A Special Bibliography (Suppl. 50) NOVEMBER 1974

IAA ENTRIES

A74-38042 # **The Ka-26 helicopter (Vertolet Ka-26).** A. F. Vakhitov. Moscow, Izdatel'stvo Transport, 1973. 168 p. In Russian.

The present work gives a full description of the Ka-26 helicopter and its main systems. The Ka-26 features two 3-blade rotors mounted one above the other on a single axis and two air-cooled 325-horsepower engines. It is designed for agricultural applications (e.g., crop dusting) as well as for the transportation of freight and passengers. It features modular construction so that various fuselage and equipment configurations are possible, each geared to a particular application. Systems described include the hydraulic system, reduction, the power plant, the rotor system, landing system, de-icing equipment, radio and electronic system, and navigaids. P.T.H.

A74-38043 # **Servomechanisms of aircraft instruments - Dynamics of servomechanisms in the presence of dry friction and retardation (Pribornye servomekhanizmy letatel'nykh apparatov - Dinamika servomekhanizmov pri nalichii sukhogo treniia i zapazdyvaniia).** V. V. Petrov and B. A. Marchukov. Moscow, Izdatel'stvo Mashinostroenie, 1973. 223 p. 32 refs. In Russian.

The dynamics of servomechanisms in the presence of dry friction in the sensitive element or the comparison element is studied with allowance for retardation in changeover switching. The analysis is limited to systems in which friction may be expressed in a Coulomb approximation (i.e., where dynamic friction is constant and equal to the maximum value of static friction). Some aspects of the design and calculation of systems operating in a vibrational mode that tends to reduce the unfavorable effect of friction forces are discussed. Means of compensating for dry friction forces arising in the displacement of the sensitive element are examined. A procedure for designing a universal device capable of performing the functions of several navigation and flight instruments is described. V.P.

A74-38046 # **Filtration of aviation fuels (Fil'tratsiia aviatsionnykh topliv).** K. V. Rybakov. Moscow, Izdatel'stvo Transport, 1973. 164 p. 111 refs. In Russian.

The present work discusses in detail the problem of contamination of aviation fuel and the means of studying and dealing with the problem. On the basis of many measurements, the process of contamination is studied from the refinery to the fuel nozzle. The effects of various degrees of contamination are investigated, and standards for fuel purity are discussed. Modern filtration systems are described, and the filtering properties of various materials (fabrics, nonfabrics, papers, etc.) are compared. P.T.H.

A74-38049 # **Air transport. Volume 3 (Vozdushnyi transport. Volume 3).** Z. P. Rumiantseva and N. G. Savusia. Moscow, VINITI, 1973. 132 p. 105 refs. In Russian.

The technical and economic aspects of the development of air transportation are reviewed, and methods of predicting air transportation over 10 to 15 year periods are discussed. The current status and developmental trends of passenger aircraft are reviewed. The irregularity and inconsistency characterizing the development of civil aviation during the past decade are noted, along with the competitive struggle for markets between regular airlines and charter organizations of the western world, and the economic integration and cooperation between individual airlines. V.P.

A74-38098 Optimization of air routes with a view to minimizing the risk of collision (Optimisation des routes aériennes en vue de minimiser le risque de collision). L. F. Pau and B. Nilsson (Danmark Tekniske Hogskole, Lyngby, Denmark). *Navigation* (Paris), vol. 22, July 1974, p. 259-274. 29 refs. In French.

Putting in service the new airport of Copenhagen-Saltholm, Denmark, temporarily requires the utilization of two neighboring airports. For this reason, it is considered necessary to optimize the flight procedures and the air routes, in order to make the two airports independent while minimizing the risk of collision. A three-dimensional geometric model of the air space in the terminal zone is proposed, and a procedure of optimization which minimizes the number of potential conflicts and the risks of collision at these points. A formula is given to evaluate them in the case of two secant or neighboring trajectories. F.R.L.

A74-38140 Hybrid heavy-lift vehicle under study. D. E. Fink. *Aviation Week and Space Technology*, vol. 101, July 29, 1974, p. 49-51.

The proposed Megalifter semi-lighter-than-air vehicle is described. It was originally intended to carry the NASA space shuttle orbiter vehicle and external propellant tank, but is suitable for transport of heavy equipment or large volumes of light cargo like liquid or gaseous fuels. It is a hybrid of an airship, a conventional winged aircraft, and a lifting body, adaptable to either STOL or VTOL operation. Helium buoyant gas maintained in a constant volume envelope offsets the greater part of the payload/lifting frame weight, while the large wingspan and the combined thrust of four large engines do the rest. Vectored thrust engines on the wingtips provide computer-controlled control augmentation needed for dealing with extreme turbulence or flight emergencies. Total weight is over a million pounds, wingspan is 530 ft, maximum payload is 200 tons. J.K.K.

A74-38149 # **Protection of civil aviation aircraft against fire (Zabezpieczenie przeciwpozarowe samolotow cywilnych).** A. Lesiuk. *Technika Lotnicza i Astronautyczna*, vol. 29, Mar. 1974, p. 4-9. 7 refs. In Polish.

Factors which may cause ignition of combustible mixtures in aircraft fuel systems are examined, with particular reference to high temperatures, leakage, electrostatic charges at the aircraft surface (electric discharges during flight), and lightnings passing through the aircraft. Safety measures for aircraft fuel systems, based on the use of fuel tank inerting with liquid nitrogen and the use of fire protection agents (such as BCF) are discussed, and the principal universal fire-precaution requirements and regulations are reviewed. V.P.

A74-38150 # **Guidelines for selecting the parameters of a slab tailplane (Wytyczne doboru parametrow plytowego usterzenia wysokosci).** J. Sandauer (Instytut Lotnictwa, Warsaw, Poland). *Technika Lotnicza i Astronautyczna*, vol. 29, Mar. 1974, p. 23-29. In Polish

The stability and maneuverability characteristics of slab tailplane are analyzed, with particular reference to the factors responsible for the difference in the characteristics of aircraft with conventional and slab tailplanes. The performance of a slab tailplane with and without a balance tab is examined. A method for evaluating and selecting the aerodynamic parameters of a slab tailplane is proposed which takes into account such aircraft characteristics as the maneuver and static margins with stick fixed, and the force gradients at the stick for constant and accelerated flying speeds. V.P.

A74-38158 **S.S.T. flight-profile optimisation.** W. J. Wilson (Waterloo, University, Waterloo, Ontario, Canada). *Institution of Electrical Engineers, Proceedings*, vol. 121, July 1974, p. 739-745. 15 refs.

The development of a practical method for the calculation of optimal flight profiles for the supersonic transport Concorde is described. Existing optimization techniques are modified to reduce the long computation times usually required for this type of problem. A modified 'stopping-condition' approach is introduced to deal with the free terminal time problem. Switching times are used as control parameters to govern the use of reheat thrust on the aircraft, resulting in discontinuities in the state equations. The conjugate-gradient technique, with some modifications, is used in the solution of the problem. The definition of the inner product of the gradients is altered to accommodate the combined use of control variables and control parameters. Also, an alternative method to the restart approach for reducing the effect of error accumulation in the search directions is introduced. Finally, the effect of gradient scaling on the convergence of the problem is demonstrated. (Author)

A74-38249 * # **Management of analytical redundancy in digital flight control systems for aircraft.** R. C. Montgomery and D. B. Price (NASA, Langley Research Center, Flight Dynamics and Control Div., Hampton, Va.). *American Institute of Aeronautics and Astronautics, Mechanics and Control of Flight Conference, Anaheim, Calif., Aug. 5-9, 1974, Paper 74-887.* 11 p. Members, $1.50; nonmembers, $2.00.

This paper presents a design method for optimal redundancy management for nonlinear systems with application to highly maneuvering aircraft. The approach taken is based on selecting the failure states to be covered by the system design and constructing a cost function that represents the cost of making an incorrect decision. The decision logic which minimizes the cost requires a bank of extended Kalman filters running in parallel. This produces a severe computational requirement. To reduce this requirement, a sub-optimal logic is developed based on using a nonlinear single-stage prediction algorithm in the filters with filter gains and decision logic selected using steady-state results obtained from a linearization of the vehicle and sensor dynamics. The design process is then applied to designing a redundancy management system for the F8-C aircraft. Results indicate that the system is superior in failure detection to a system using the same structure but using a linear single-stage prediction algorithm in the filters. (Author)

A74-38295 * **Quiet engine from NASA.** N. D. Sanders and E. W. Conrad (NASA, Lewis Research Center, Cleveland, Ohio). *Flight International*, vol. 106, July 25, 1974, p. 87-89.

Engine designs resulting from the NASA sponsored quiet engine program are described in terms of their possible use on the DC-8. These engines have high bypass ratios for low jet noise and low-speed, low-noise fans. Experiments were carried out on various fan designs with different tip speeds. The advantage of low tip speeds and high lift coefficients has been demonstrated. The engines are equipped with flight-standard nacelles with acoustic suppression. It is estimated that these improvements will reduce DC-8 noise by about 26EPNdB-29EPNdB. J.K.K.

A74-38310 # **System for guiding fixed- or rotary-wing aircraft in approach and landing zones (Système de guidage d'avions et d'hélicoptères en zone d'approche et d'atterrissage).** J. Besson (ONERA, Châtillon-sous-Bagneux, Hauts-de-Seine, France). *(NATO, AGARD, Meeting on Guidance and Control of V/STOL Aircraft and Helicopters at Night and in Poor Visibility, Stuttgart, West Germany, May 14-16, 1974.) ONERA, TP* no. 1342, 1974. 9 p. 14 refs. In French.

A system capable to provide guidance over several kilometers, or also ground control, for aircraft in approach of landing is proposed. Based on measurement of distances between the moving aircraft and a number of ground stations, the system offers the advantages of avoiding frequency cluttering through use of time multiplexing and of lending itself to integration in a multifunction system. M.V.E.

A74-38311 # **Theoretical and experimental study of boundary layer blowing at the hinge of a lift-augmenting flap (Etude théorique et expérimentale du soufflage de couche limite à la charnière d'un volet hypersustentateur).** B. Monnerie and G. Lovat (ONERA, Châtillon-sous-Bagneux, Hauts-de-Seine, France). *(NATO, AGARD, Meeting on V/STOL Aerodynamics, Delft, Netherlands, Apr. 24-26, 1974.) ONERA, TP* no. 1367, 1974. 21 p. 5 refs. In French.

The lift augmentation effect by boundary layer blowing was studied with a special setup installed in a subsonic 3-meter-diam wind tunnel. The means by which the problem of obtaining satisfactory two-dimensional boundary layers on a lift-augmenting flap was solved are described. A set of complete data on the development of mixed flow between the jet and the boundary layer is obtained. The experimental data are verified theoretically, using a turbulence model based on the Nee-Kovasznay equation for the viscosity coefficient. V.P.

A74-38315 **The energy crisis of fuel and the procedures of cruising flight (La crisis energética de combustible y los procedimientos de vuelo de crucero).** M. Cuesta Alvarez. *Revista de Aeronáutica y Astronáutica*, vol. 34, June 1974, p. 444-460. In Spanish.

The energy crisis has focused attention on questions concerning the aircraft type with the lowest operational fuel consumption. Other important questions are related to the flight procedures which have optimum characteristics with regard to fuel consumption and total operational costs. It has been found that aircraft equipped with turbojet engines require the lowest amount of fuel for their operation. Details of turbojet design and operation are discussed along with questions of cruising range, thrust, and velocity, taking into account conditions at various altitudes. The characteristics of cruising flight undertaken under conditions of constant Mach number and constant altitude and of constant thrust and constant altitude are considered. G.R.

A74-38393 **The jet density exponent issue for the noise of heated subsonic jets.** R. Mani (GE Research and Development Center, Schenectady, N.Y.). *Journal of Fluid Mechanics*, vol. 64, July 8, 1974, p. 611-622. 16 refs. Research supported by the U.S. Department of Transportation and U.S. Air Force.

An investigation is conducted concerning the variation in the sound power of a jet of constant exit velocity with a change in the

jet exit density. The experimentally observed results seem to admit an explanation based on the influence of the shrouding effect of a jet flow on the radiative efficiency of moving acoustic sources. The change in efficiency is calculated with the aid of a simple model. The jet density exponent is found to depend both on the jet Mach number and on a source frequency parameter. The theoretical results are compared with experimental studies of the problem. G.R.

A74-38403 # **An investigation of corrugated metallic diaphragm capsules as used in aircraft instrument pressure elements.** R. Yokoi (Nihon University, Tokyo, Japan). *Japan Society for Aeronautical and Space Sciences, Transactions,* vol. 17, no. 36, 1974, p. 76-90. 13 refs.

Theoretical and experimental investigation of the maximum deflection of corrugated metallic diaphragm capsules. The results presented should prove useful in the design manufacture and testing of all types of diaphragms, as well as in the selection of materials for diaphragms. M.V.E.

A74-38497 # **The Dolphin airship with an undulating propulsion system and its many uses as crane and operational aircraft (Delphinluftschiff mit Wellantrieb-vielseitig verwendbar als Kran- und Arbeitsluftschiff).** U. Queck (Kammer der Technik, Berlin, East Germany). *Technisch-ökonomische Informationen der zivilen Luftfahrt,* vol. 10, no. 3, 1974, p. 161-165. In German.

Disadvantages regarding the use of a helicopter as a crane are mainly related to its limited lifting capacity. This drawback can be overcome by a new type of aircraft, the Dolphin airship, which combines in certain respects the properties of a helicopter, airship, and conventional aircraft. The uplift provided by the helium-filled body of the Dolphin airship compensates for the weight of the aircraft and maintains the aircraft in a floating position. The capacity for lifting the load and moving the aircraft vertically upward or downward is provided by a propulsion system of novel characteristics. It is estimated that the optimal lifting capacities for the operation of the Dolphin airship as crane are in the range from 5,000 to 500,000 kg. G.R.

A74-38498 # **Aerodynamic analysis of different flight attitudes of conventional aircraft. XI - Aerodynamic principles /Aerodynamics of the wing: Forces and moments of force of the air in the case of rectilinear flight at low Mach numbers/ (Flugmechanische Analyse verschiedener Flugzustände konventioneller Flugzeuge. XI - Aerodynamische Grundlagen /Aerodynamik des Tragflügels: Luftkräfte und Luftkraftmomente im Geradeausflug bei kleinen Machzahlen/).** F. Seidler (Hochschule für Verkehrswesen, Dresden, East Germany). *Technisch-ökonomische Informationen der zivilen Luftfahrt,* vol. 10, no. 3, 1974, p. 166-184. In German.

The general motion of the wing can be divided into a number of forms of motion, related to the rectilinear flight, sideslipping, the dutch roll, pitching, and yawing. Three-component measurement and the graphical representation of the obtained values are discussed along with questions regarding the dependence of the lift on the angle of attack, the dependence of the drag on the angle of attack, the characteristics of the polar, aerodynamic quality and lift drag ratio, the dependence of the pitching moment on a the angle of attack and the lift, the center of pressure, and the aerodynamic center. G.R.

A74-38499 **The low technology airship.** E. Mowforth (Surrey University, Guildford; Airfloat Transport, Ltd., England). *New Scientist,* vol. 63, July 25, 1974, p. 178-180.

Discussion of the Airfloat airship program aimed at the design of an airship that could carry up to 400 tons as a single 'door-to-door' payload over a range of about 1000 miles. The program emphasizes a rigorous minimization of research and development and the greatest possible use of currently available units, installations, systems, techniques, materials, and experience in the interest of immediate commercial effectiveness. The economics of alternative designs and various applications are briefly reviewed. M.V.E.

A74-38523 **Air Force findings and recommendations on digital aircraft avionics.** E. C. Gangl (USAF, Aeronautical Systems Div., Wright-Patterson AFB, Ohio). In: NAECON '74; Proceedings of the National Aerospace and Electronics Conference, Dayton, Ohio, May 13-15, 1974. New York, Institute of Electrical and Electronics Engineers, Inc., 1974, p. 72-77. 8 refs.

Improved capabilities and performance of aircraft weapons systems are shown to be made possible by proper use of digital avionics without the usual companions of complexity, lowered reliability, and high costs. The prerequisites to an early realization of these possibilities are pointed out. M.V.E.

A74-38533 **Considerations in the design of a digital flight control function for a high performance aircraft.** J. G. Mrazek (Texas Instruments, Inc., Dallas, Tex.) and D. P. Rubertus (USAF, Flight Dynamics Laboratory, Wright-Patterson AFB, Ohio). In: NAECON '74; Proceedings of the National Aerospace and Electronics Conference, Dayton, Ohio, May 13-15, 1974. New York, Institute of Electrical and Electronics Engineers, Inc., 1974, p. 186-193.

Current interest in applying digital information management techniques to a broad spectrum of military aircraft functions has stimulated increased attention to identifying the design criteria required to achieve satisfactory dynamic performance in a digital flight control function. The investigation uses an analog, quadruple, fly-by-wire system as a model. The flight control algorithms were developed from the analog filter definitions using the Tustin transformation. A data rate was selected for each segment of the system in the interest of distributing the processor load to the best overall advantage. The computer load was assessed using the flight control algorithms and data rates associated with each loop segment. It was determined that the computation cycle time was dominated by the redundancy management function. (Author)

A74-38535 **A low power night photo system for high speed unmanned aircraft.** H. Fledel and H. S. Lapp (USAF, Avionics Laboratory, Wright-Patterson AFB, Ohio). In: NAECON '74; Proceedings of the National Aerospace and Electronics Conference, Dayton, Ohio, May 13-15, 1974. New York, Institute of Electrical and Electronics Engineers, Inc., 1974, p. 203-207.

The Air Force Avionics Laboratory has developed a night photo system, designated as the KS-126A. The system consists of a pulsed illuminator synchronized to a single 70-mm camera. The camera is unique in two respects; (1) one of its components is an 80-mm-diam, one-stage, image amplifier tube; (2) the camera makes use of a rotating carousel or turntable having three prisms, each one providing a 40 x 40 deg view of the ground. The system was delivered in an RF4C centerline pod so that flight testing could be effectively accomplished by a controllable high-performance aircraft. However, the system was designed for installation into, and operation from a low-altitude drone. (Author)

A74-38551 **A digital multimode flight control system for tactical fighters.** K. Bassett and T. Yechout (Honeywell, Inc., Minneapolis, Minn.). In: NAECON '74; Proceedings of the National Aerospace and Electronics Conference, Dayton, Ohio, May 13-15, 1974. New York, Institute of Electrical and Electronics Engineers, 1974, p. 300-307.

Review of a program for the development of a digital multimode flight control system aimed at a flight test evaluation on an A-7D tactical aircraft. Among the achievements to be realized by the program are: (1) the validation of computation parameter requirements for tactical aircraft; (2) flight evaluations of digital multimodes usable for weapons delivery missions; (3) real-world testing of redundancy and self-test concepts; and (4) experience in soft-ware validation and control for digital flight control systems. Each of these achievements is expected to result in appreciable benefits for future advanced flight control applications. M.V.E.

A74-38552 **Advanced environmental control system.** W. C. Savage (USAF, Flight Dynamics Laboratory, Wright-Patterson AFB, Ohio). In: NAECON '74; Proceedings of the National Aerospace and Electronics Conference, Dayton, Ohio, May 13-15, 1974. New York, Institute of Electrical and Electronics Engineers, Inc., 1974, p. 308-310.

The described environmental control system is being developed to provide high environmental reliability of aircraft subsystems. Delivery of a steady supply of clean cool dry air under all mission conditions is ensured by using an improved heat exchanger/separator combination to remove effectively large amounts of moisture and to eliminate wasteful reheat. The design of the high-pressure condensing automatically rotating heat exchanger is described. V.P.

A74-38554 **Electromagnetic compatibility considerations in system integration.** E. E. Wick (USAF, Aeronautical Systems Div., Wright-Patterson AFB, Ohio). In: NAECON '74; Proceedings of the National Aerospace and Electronics Conference, Dayton, Ohio, May 13-15, 1974. New York, Institute of Electrical and Electronics Engineers, 1974, p. 317-324.

A number of technical considerations for an EMC (electromagnetic compatibility) program are outlined. The implementation of these important EMC aspects as an integral and logical part of aircraft system integration is described. It is shown that the basic engineering tools necessary to achieve system electromagnetic compatibility are available by subsystem/equipment design with careful consideration of electromagnetic interference control and computer-aided EMC analysis. V.P.

A74-38555 **Improving Mean-Time-Between-Maintenance-Actions - A recommended system approach.** R. C. Perdzock (USAF, Wright-Patterson AFB, Ohio). In: NAECON '74; Proceedings of the National Aerospace and Electronics Conference, Dayton, Ohio, May 13-15, 1974. New York, Institute of Electrical and Electronics Engineers, Inc., 1974, p. 325-331.

A wide discrepancy continues to exist between Mean-Time-Between-Failure (MTBF) for pieces of avionic equipment as determined from qualification tests and the Mean-Time-Between-Maintenance-Action (MTBMA) attained in operation. The present work discusses some of the probable causes for this discrepancy. Available data indicate that major strides can be made by improving Built-In-Test (BIT) and Aerospace Ground Equipment (AGE) design to assure that malfunctions are correctly diagnosed. It is urged that reliability testing and test of BIT and AGE capability be initiated as early in the design phase as possible. These tests should be carried out in stepwise fashion to allow a test-fix test concept against increasingly difficult test requirements. P.T.H.

A74-38556 **Multiple channel same frequency repeater flight test.** J. J. Nehez (USAF, Avionics Laboratory, Wright-Patterson AFB, Ohio). In: NAECON '74; Proceedings of the National Aerospace and Electronics Conference, Dayton, Ohio, May 13-15, 1974. New York, Institute of Electrical and Electronics Engineers, Inc., 1974, p. 333-340. 5 refs.

Line-of-sight range limitations at UHF frequencies motivated a laboratory effort to investigate and develop radio relay concepts and techniques. Requirements of compatibility with existing equipments, ease of installation, and simplicity of operation led to the Same Frequency Repeater (SFR) program. Program background, problem areas, design approaches, and problem solutions are presented. The Multiple Channel SFR flight test is described. (Author)

A74-38557 **A simple antenna system approach for mobile SATCOM terminals.** I. D. Larson (Motorola, Inc., Government Electronics Div., Scottsdale, Ariz.). In: NAECON '74; Proceedings of the National Aerospace and Electronics Conference, Dayton, Ohio, May 13-15, 1974. New York, Institute of Electrical and Electronics Engineers, Inc., 1974, p. 341-345.

The application of predetection combining to the problem of UHF Communications between a satellite and a mobile platform such as an aircraft is discussed. To overcome the problems normally encountered in airborne SATCOM terminals such as antenna shadowing by parts of the aircraft during maneuvers and multipath fading on the aircraft receiving system, multiple antennas are employed at various locations on the aircraft fuselage. A four-channel predetection combiner receives the inputs from these antennas and combines them in phase in an optimum manner, thus providing an overall effective antenna gain and a more uniform and continuous receiving antenna pattern around the aircraft. Data is presented illustrating this combining technique applied to aircraft and ships. (Author)

A74-38558 **Implementation considerations with PSK modulation.** J. J. Foshee (Electronic Communications, Inc., St. Petersburg, Fla.). In: NAECON '74; Proceedings of the National Aerospace and Electronics Conference, Dayton, Ohio, May 13-15, 1974. New York, Institute of Electrical and Electronics Engineers, Inc., 1974, p. 346-349. 8 refs.

Phase shift keying (PSK) is attractive not only because of its bandwidth economy but it is theoretically more efficient than simple Frequency Shift Keying (FSK) in the presence of Gaussian noise. Two types of PSK modulation schemes have received considerable attention. In the biphase (BPSK) mode the phase of the carrier is divided into two states separated by 180 deg with each state defining a binary. For BPSK the keying rate is equal to the data rate. In the quadriphase (QPSK) mode two binary bits are used to define one of four possible phase states of the carrier with each phase state separated from the adjacent phase states by 90 deg. For QPSK the keying rate is equal to one-half the data rate. F.R.L.

A74-38559 **Bandwidth filtering effects on PSK modulation.** R. V. Groves and R. C. Beach (USAF, Avionics Laboratory, Wright-Patterson AFB, Ohio). In: NAECON '74; Proceedings of the National Aerospace and Electronics Conference, Dayton, Ohio, May 13-15, 1974. New York, Institute of Electrical and Electronics Engineers, Inc., 1974, p. 350-356.

The communications channel bandwidth of the military UHF band will, in the future, be reduced from 100 to 25 kHz. This reduction in channel bandwidth can have an effect on the ability to adequately transmit digitized information using phase shift keyed (PSK) modulation. Due to the nature of PSK modulation, the modulator produces a very broad spectrum of sidebands which can extend beyond channel bandwidth limitations and produce adjacent channel interference. This paper presents a discussion of the effects of bandwidth limiting on adjacent channel interference and system performance using Hi-Q bandpass filters. (Author)

A74-38560 **Airborne Ka band satellite communications terminal development.** T. E. Joyner (USAF, Avionics Laboratory, Wright-Patterson AFB, Ohio). In: NAECON '74; Proceedings of the National Aerospace and Electronics Conference, Dayton, Ohio, May 13-15, 1974. New York, Institute of Electrical and Electronics Engineers, Inc., 1974, p. 357-361.

A system development is currently being pursued by the Air Force for an airborne millimeter-wave communications terminal operating in the 36-38.6 GHz frequency band. The communications terminal will have the capability of providing extended aircraft/aircraft or aircraft/ground communication through millimeter-wave satellites. The transmit and receive functions and the intended application of the millimeter-wave communications terminal are briefly described in conjunction with related functions of the satellites involved. (Author)

A74-38564 **Microwave dielectric waveguide data bus system for aircraft interior data transfer.** R. M. Knox, K. J. Brandt, J. E. Kietzer (IIT Research Institute, Chicago, Ill.), and R. C. Beavin (USAF, Flight Dynamics Laboratory, Wright-Patterson AFB, Ohio). In: NAECON '74; Proceedings of the National Aerospace and Electronics Conference, Dayton, Ohio, May 13-15, 1974. New York, Institute of Electrical and Electronics Engineers, Inc., 1974, p. 381-388.

SSPC to remove faults from the line much more rapidly than a thermal circuit breaker. The high reliability and long life associated with the solid-state device is also a significant advantage of the SSPC. Another advantage comes from the SSPC's ability to be remotely reset. This eliminates the need for having the circuit breakers for flight critical loads located in the crew compartment for easy access. The reset command can be automatically transmitted by the data handling system. F.R.L.

A74-38565 A digital Mark XII IFF reply evaluator for the F-15. A. H. Miller (Litton Industries, Inc., Data Systems Div., Van Nuys, Calif.). In: NAECON '74; Proceedings of the National Aerospace and Electronics Conference, Dayton, Ohio, May 13-15, 1974. New York, Institute of Electrical and Electronics Engineers, Inc., 1974, p. 389-391.

The IFF Reply Evaluator (IRE) provides the F-15 aircraft with automatic digital processing of Mark XII IFF target replies, including automatic all-target Mode 4 evaluation. The IRE generates digital target reports which are then presented to the pilot as an interference-free display of the IFF situation in front of his aircraft. This unit automatically performs a number of operations previously performed by an operator. The IRE does the detection, location, and identification of all targets in the aircraft surveillance volume in less time than an operator can handle a single target. In addition, the results of this processing are immediately available as a digital word which may be sent to a display or entered into larger data base. (Author)

A74-38575 Solid-state power controllers for B-1 flight test. M. W. Dodge and T. R. Murrow (USAF, Aero Propulsion Laboratory, Wright-Patterson AFB, Ohio). In: NAECON '74; Proceedings of the National Aerospace and Electronics Conference, Dayton, Ohio, May 13-15, 1974. New York, Institute of Electrical and Electronics Engineers, Inc., 1974, p. 461-466.

There are several reasons why there is interest in replacing relatively simple electromechanical and thermal devices with rather complex electronic devices. The solid-state power controller's (SSPC) ability to turn on at zero voltage crossover and turn off at zero current crossover substantially reduces the electromagnetic interference associated with electromechanical switching. The overall electrical power quality is also improved because of the ability of the

The concept of multiplexing data for transfer within an aircraft is gaining wide acceptance. The usual approach to multiplexing is to digitalize the data and use a shielded twisted pair (STP) cable as a common transmission line between several terminals. Because of interference possibilities, an alternative to the STP is the fiber optic transmission line which offers complete isolation from electromagnetic interference. This paper describes a new type of data bus system which offers effectively the same isolation from interference as the fiber optic bus. It also permits frequency selective coupling to the bus, and provides a total data capacity of several GHz, sufficient for both low rate TDM data plus high data rate digital or analog signals. (Author)

A74-38576 Fiber optics as applied to Advanced Aircraft Electrical Systems. H. W. Heinzman, W. T. Turnage (LTV Aerospace Corp., Dallas, Tex.), and H. Brown (U.S. Naval Material Command, Naval Air Development Center, Warminster, Pa.). In: NAECON '74; Proceedings of the National Aerospace and Electronics Conference, Dayton, Ohio, May 13-15, 1974. New York, Institute of Electrical and Electronics Engineers, Inc., 1974, p. 467-472.

Consideration of the feasibility of applying fiber optics to the Advanced Aircraft Electrical System. Areas investigated for applying fiber optics include: (1) the bi-level discrete lines between the signal sources and multiplexers and the power controllers and demultiplexers and (2) the multiplex data bus. A new fiber optic data bus approach is presented which utilizes the advantages of fiber optics and minimizes the effects of the limitations. Using this new data bus concept, it is feasible to implement a multiterminal multiplex system in various sizes of aircraft using present stage-of-the-art technology. Also presented is an implementation technique used to demonstrate fiber optics as applied to the data-handling system that was used on the Solid State Simulator. (Author)

A74-38580 B-1 central air data computer. C. J. Sheets (AiResearch Manufacturing Company of California, Los Angeles, Calif.). In: NAECON '74; Proceedings of the National Aerospace and Electronics Conference, Dayton, Ohio, May 13-15, 1974. New York, Institute of Electrical and Electronics Engineers, Inc., 1974, p. 499-504.

The B-1 central air data computer (CADC) provides digital and analog signals for weapons delivery and air vehicle control. These functions are derived from freestream and vehicle parameters using solid-state pressure sensors and computing electronics. The pressure sensors provide accurate and high resolution digital information for processing into analog and digital output format by the microprogrammed, large-scale-integrated (LSI) computer. The CADC input and output signals are radiation-hardened through prudent circuit design. The system meets the specified goals of reliability and maintainability through good heat transfer design and modular packaging techniques. (Author)

A74-38622 * # Laminar viscous-inviscid interactions at transonic speeds. D. J. Collins (California Institute of Technology, Jet Propulsion Laboratory, Pasadena, Calif.). *AIAA Journal*, vol. 12, Aug. 1974, p. 1146-1149. 7 refs. Contract No. NAS7-100.

Some aspects of the laminar viscous-inviscid interaction at transonic speeds are discussed by examining data obtained on a 6% thick biconvex circular-arc airfoil and comparing the results with the predictions of Klineberg and Steger (1972). The results obtained from experiments are compared for Re = 140,000 and for Re = 40,000. It is clear that the theoretical results overestimate the effects of viscosity and consequently predict values for the pressure coefficient which lie below the experimental data over the range of Mach numbers given. F.R.L.

A74-38626 * # Axial flow measurements in trailing vortices. D. L. Ciffone and K. L. Orloff (NASA, Ames Research Center, Moffett Field, Calif.). *AIAA Journal*, vol. 12, Aug. 1974, p. 1154, 1155. 12 refs.

A scanning laser Doppler velocimeter was used to measure the axial velocity defect in the cores of trailing vortices behind a lifting airfoil of rectangular planform. Data were obtained at several different angles of attack and downstream distances ranging from 30 to 1000 chord lengths. The test was designed to obtain continuous data from the near field into the far field while removing uncertainties associated with the interpretation of data obtained by the hydrogen bubble technique. The measured velocities of V sub x/U sub infinity are compared with those predicted. The agreement is remarkably good over the entire range of downstream distances, which supports the credibility of calculating axial velocities using the results of Moore and Saffman (1973). F.R.L.

A74-38633 # Instantaneous velocity measurements in the near wake of a helicopter rotor. C. Maresca, J. Rebont (Aix-Marseille, Université, Marseille; CNRS, Paris, France), and D. Favier (Aix-Marseille, Université, Marseille, France). *AIAA Journal*, vol. 12, Aug. 1974, p. 1165-1167. Direction des Recherches et Moyens d'Essais Contract No. 721348.

A recent study on the near flow behind a propeller (authors, to be published) has shown that the form of the mean velocities measured just downstream of the rotation plane can illustrate the significant phenomena which occur upon the blades. Such a method seemed to be applicable to a helicopter rotor wake. However, the unsteady nature of such a flow requires that the instantaneous velocities be measured. The three instantaneous velocity components have been measured by use of a hot film wedge-shaped probe, located in the near wake of a two-bladed rotor tilted at -10 deg. the untwisted blade (profile NACA 0018) has a rectangular shape. F.R.L.

A74-38692 # **Radomes of microwave antennas - Radio engineering design and calculation (Obtekateli antenn SVCh - Radiotekhnicheskii raschet i proektirovanie).** V. A. Kaplun. Moscow, Izdatel'stvo Sovetskoe Radio, 1974. 240 p. 104 refs. In Russian.

The aim of the book is to provide data that would enable the engineer to chose the most rational design of modern radome configurations for a specific range of wavelengths and specific operational conditions. Attention is given to such problems as the passage of electromagnetic waves through dielectric elements of various shape and through multilayer dielectric elements with incorporated metallic periodic grids, and to the design of radiowave transmitting radomes and multifrequency radomes. V.P.

A74-38694 **Instruments of flight: A guide to the pilot's flight panel of a modern airliner.** M. Siberry (Court Line Aviation, Ltd., Luton, Beds., England). New York, Crane, Russak and Co., Inc., 1974. 120 p. $7.50.

The instruments and systems covered include air-operated indicators, gyroscopic instruments, flight directors, autopilots, radio and inertial navigation systems, and weather radar. Aircraft altimeters are discussed along with captain's instrument panels in various aircraft, turn and slip indicators, a horizontal situation indicator, a radio magnetic indicator, airspeed indicators, a flight director system of the future, and a vertical speed indicator. A description is given of the techniques of automatic landings. G.R.

A74-38713 # **VFW 614, quiet short haul airliner.** H. Kathen (Vereinigte Flugtechnische Werke-Fokker GmbH, Bremen, West Germany). *American Institute of Aeronautics and Astronautics, Aircraft Design, Flight Test and Operations Meeting, 6th, Los Angeles, Calif., Aug. 12-14, 1974, Paper 74-937.* 12 p.

Review of the design and performance characteristics of the quiet short-haul airliner, VFW 614, developed as a joint European project and to go into production in 1975. It is believed to be one of the world's quietest airliners. Its high blockspeed and superior maintainability features are shown to result in low direct operation costs. M.V.E.

A74-38714 # **High-lift aerodynamics /37th Wright Brothers Lecture/.** A. M. O. Smith (Douglas Aircraft Co., Long Beach, Calif.). *American Institute of Aeronautics and Astronautics, Aircraft Design, Flight Test and Operations Meeting, 6th, Los Angeles, Calif., Aug. 12-14, 1974, Paper 74-939.* 44 p. 68 refs.

The lecture surveys the state of theory and calculational capability with respect to the problems of obtaining high lift. History, theoretical limits of lift, and economics are discussed briefly. The paper deals at length with the ability of boundary layers to endure the pressure rise created by airfoils in high-lift attitudes. It also considers at length the pressure rises that are imposed by various geometries together with ways of alleviating their adverse effects. Considerable attention is given to the problem of obtaining favorable interference in multielement systems. Optimum airfoils and several other extremes are described. The paper concludes with a discussion of certain recent developments, including power-augmented lift and inverse-airfoil techniques. (Author)

A74-38715 # **U.S. Army helicopter icing qualification program.** R. B. Lewis, II (U.S. Army, Aviation Engineering Flight Activity, Edwards AFB, Calif.). *American Institute of Aeronautics and Astronautics, Aircraft Design, Flight Test and Operations Meeting, 6th, Los Angeles, Calif., Aug. 12-14, 1974, Paper 74-942.* 8 p. 17 refs.

A series of simulated and natural icing tests have been conducted to determine the capability of Army helicopters to operate in icing conditions. A helicopter icing simulation system, instrumentation, and experimental procedures have been developed to quantify icing effects on engine and vehicle performance, handling qualities, and structural vibrations. Test findings on UH-1H, AH-1G, and CH-47C helicopters include increased level flight power requirements, reduced autorotational capability, asymmetric main rotor ice shedding causing severe vibration, damage to engines and rotor blades from shed ice, and identification of inadequate components, including windshields and antennas. Future efforts include qualification testing of other Army helicopters and examination of advanced helicopter ice protection systems. (Author)

A74-38716 # **A broad view of Navy S-3A testing.** G. E. Jessen (U.S. Naval Air Systems Command, Washington, D.C.). *American Institute of Aeronautics and Astronautics, Aircraft Design, Flight Test and Operations Meeting, 6th, Los Angeles, Calif., Aug. 12-14, 1974, Paper 74-943.* 12 p.

Emphasis is on testing, principally Navy testing as it was envisioned, grew in shape and size, and became history. During this period there was significant DOD interest in testing and its application to management decisions. The basic approach is to carefully reconstruct the many Navy testing requirements which were determined to be essential, followed by a recitation of how they were accomplished. Related procurement events such as Defense Systems Acquisition Review Council reviews of this project are also treated. Essentially, the basic development plan for the S-3A Viking was sound and adequately staffed. It is noted that test philosophies can grow and change during the life of a program and still be absorbed into a well structured program. F.R.L.

A74-38717 # **Flight testing the Fokker F28 with advanced wing.** T. Schuringa (Fokker-VFW, Schiphol Oost, Netherlands). *American Institute of Aeronautics and Astronautics, Aircraft Design, Flight Test and Operations Meeting, 6th, Los Angeles, Calif., Aug. 12-14, 1974, Paper 74-944.* 7 p.

Description of the development and flight testing of the latest version of the Fokker F28 aircraft which features an aerodynamically advanced wing with leading-edge slats and 6% larger span. The purpose of the wing modification was to retain the good runway performance and operating range of earlier versions while permitting higher gross weights. The flight test program, test instrumentation, and structural modifications of the aircraft are described along with flight performance data. T.M.

A74-38718 # **Aircraft/engine jet noise control - A survey.** E. J. Stringas (General Electric Co., Cincinnati, Ohio) and R. Mani (General Electric Co., Schenectady, N.Y.). *American Institute of Aeronautics and Astronautics, Aircraft Design, Flight Test and Operations Meeting, 6th, Los Angeles, Calif., Aug. 12-14, 1974, Paper 74-947.* 25 p. 12 refs.

Review of the main aeroacoustic characteristics of a wide range of jet noise suppressor systems. High flow ejectors, simple primary and secondary systems, fluid injection, multi-tube, multi-spoke/chute, and many other suppression techniques were evaluated for both circular and annular (plug) nozzle applications. System studies included choked inlet, open area exhaust, and turbomachinery suppression techniques. A.B.K.

A74-38719 # **Progress in core engine and turbine noise technology.** D. C. Mathews and A. A. Peracchio (United Aircraft Corp., Pratt and Whitney Aircraft Div., East Hartford, Conn.). *American Institute of Aeronautics and Astronautics, Aircraft Design, Flight Test and Operations Meeting, 6th, Los Angeles, Calif., Aug. 12-14, 1974, Paper 74-948.* 14 p. 30 refs.

The characteristics of both low frequency core engine noise and high frequency turbine noise are reviewed, and several possible noise generating mechanisms are indicated. These mechanisms include contributions from the combustor, the turbine, the exhaust struts and the nozzle lip. An experimental test program on a JT3D turbofan engine, aimed at obtaining a further definition of the major source mechanisms for both core engine and turbine noise, is described. The effect of noise propagation through both the duct and turbulent exhaust flow on core engine and turbine far field noise characteristics is illustrated. Methods for noise control and reduction are discussed, including the use of acoustic liners for noise absorption. Areas also are defined where further research is needed. The impact of present and anticipated noise certification require-

ments on the need for core engine and turbine noise reduction is indicated. (Author)

A74-38720 # **Flight test investigation of the sailplane as a post-stall research vehicle.** D. T. Ward (U.S. Air Force, Osan AFB, Korea) and A. G. Bennett, Jr. (Mississippi State University, Mississippi State, Miss.). *American Institute of Aeronautics and Astronautics, Aircraft Design, Flight Test and Operations Meeting, 6th, Los Angeles, Calif., Aug. 12-14, 1974, Paper 74-951.* 9 p. 11 refs. Contract No. F33615-72-C-1119.

An LK-10A sailplane has been used to explore the potential of sailplanes for post-stall research. The aircraft was modified to include an anti-spin parachute and an experimental, government-furnished instrumentation package. The anti-spin parachute was qualified in flight prior to post-stall tests. The LK-10A spun readily only at aft CG loadings, although developed spins were achieved at both aft and mid CG loadings. Two mildly oscillatory spin modes were observed, one steep and one relatively flat (approximately 35 and 55 deg average angle of attack, respectively). Aerodynamic controls were highly effective for recovery from either spins or poststall gyrations, although the anti-spin parachute was deployed in one spin for demonstration purposes. (Author)

A74-38721 * # **NASA flight research on aircraft wake vortices and minimization concepts.** H. A. Verstynen, Jr. (NASA, Aviation Safety Technology Branch, Washington, D.C.). *American Institute of Aeronautics and Astronautics, Aircraft Design, Flight Test and Operations Meeting, 6th, Los Angeles, Calif., Aug. 12-14, 1974, Paper 74-953.* 11 p. 19 refs.

A74-38722 # **Another look at landing and stopping criteria.** T. G. Foxworth and H. F. Marthinsen (Air Line Pilots Association, Washington, D.C.). *American Institute of Aeronautics and Astronautics, Aircraft Design, Flight Test and Operations Meeting, 6th, Los Angeles, Calif., Aug. 12-14, 1974, Paper 74-956.* 48 p. 235 refs.

Review of the elements affecting the success of the aircraft landing and stopping maneuver. It is concluded that a reevaluation of the parameters governing landing distance determination is required and that this reevaluation must be based on more rational criteria than those currently in effect. In particular, the approach must be stabilized in configuration, flight path, and speed below 1500 feet above the landing surface, and multisegment paths should be prohibited. The landing distance required should be measured from the point at which the lowest point of the aircraft is 50 feet above the landing surface. In addition, when considering aircraft compatibility with approach guidance systems likely to be used in airline service, a nominal wheel height of no lower than 30 feet over the threshold must be imposed as a basis for aircraft design. A.B.K.

A74-38724 # **Influence of runway traction on operation of jet transport aircraft.** J. A. Ferrarese (FAA, Flight Operations Div., Washington, D.C.). *American Institute of Aeronautics and Astronautics, Aircraft Design, Flight Test and Operations Meeting, 6th, Los Angeles, Calif., Aug. 12-14, 1974, Paper 74-958.* 13 p. 31 refs.

An operational viewpoint is given concerning the impact of contaminated runway surfaces on day-to-day operation of jet transport aircraft. The discussion deals with a variety of runway-related problems and promising solutions that could significantly reduce operational hazards associated with slippery runways. In recent years considerable progress has been made in runway pavement science, operational procedures, and appropriate tests to determine the reliability and efficiency of runway surfaces, ground friction measuring devices, and operational procedures to effectively accomodate the aircraft/runway interface. Many of these valuable contributions are reviewed and analyzed. F.R.L.

A74-38725 * # **Air transportation - Energy cost-effective or not.** D. V. Maddalon (NASA, Langley Research Center, Aeronautical Systems Office, Hampton, Va.). *American Institute of Aeronautics and Astronautics, Aircraft Design, Flight Test and Operations Meeting, 6th, Los Angeles, Calif., Aug. 12-14, 1974, Paper 74-959.* 20 p. 17 refs.

Current technology aircraft have energy intensities comparable to ground transport modes. Operational changes can further improve their relative energy performance. Wide-body aircraft have already significantly improved fleet energy intensity and will continue to do so as they become more predominant. This is reflected in the 1972 fleet-wide energy intensity data which show both the domestic and international carriers at the lowest jet aircraft intensity levels ever attained. Technological improvements decreased the energy requirements of wide-body aircraft while also significantly reducing aircraft noise and pollution emission levels. Load factor is the most significant parameter affecting existing aircraft energy intensity and therefore should be raised. Fuel scarcity is now forcing such a change. F.R.L.

A74-38727 # **Aircraft structures designed to cost.** L. J. Marchinski (Boeing Vertol Co., Philadelphia, Pa.). *American Institute of Aeronautics and Astronautics, Aircraft Design, Flight Test and Operations Meeting, 6th, Los Angeles, Calif., Aug. 12-14, 1974, Paper 74-962.* 14 p.

Discussion of an active step-by-step design-to-cost aircraft development program which calls for cost, weight and performance considerations in every design decision aimed at cost reduction at every design stage from top management down to the drawing board designer. The program also calls for the establishment of parts-count targets for each structural design and for a documentation system with a manual of design-to-cost specifications. The program implies the enhancement of cost consciousness and discipline in both government and industrial management. V.Z.

A74-38728 # **Design-to-cost for the A-10 close air support aircraft.** C. W. Adams and U. A. Hinders (USAF, Aeronautical Systems Div., Wright-Patterson AFB, Ohio). *American Institute of Aeronautics and Astronautics, Aircraft Design, Flight Test and Operations Meeting, 6th, Los Angeles, Calif., Aug. 12-14, 1974, Paper 74-963.* 5 p.

Discussion of the design philosophy and performance characteristics of the A-10 aircraft shown to embody the specific weapon system that fulfills the mission requirements of close air support for ground forces at an average unit flyaway cost of $1.5 million in 1970 dollars for 600 aircraft at peak rate of 20 per month. The underlying design-to-cost concept is believed to result in significantly superior cost efficiency than would otherwise be possible. M.V.E.

A74-38729 * # **Costs and benefits of composite material applications to a civil STOL aircraft.** T. R. Logan (Douglas Aircraft Co., Long Beach, Calif.). *American Institute of Aeronautics and Astronautics, Aircraft Design, Flight Test and Operations Meeting, 6th, Los Angeles, Calif., Aug. 12-14, 1974, Paper 74-964.* 9 p. 19 refs. Contract No. NAS2-69941.

Costs and benefits of advanced composite primary airframe structure were studied to determine cost-effective applications to a civil STOL aircraft designed for introduction in the early 1980 time period. Applications were assessed by comparing costs and weights with a baseline metal aircraft which served as a basis of comparison throughout the study. Costs as well as weights were estimated from specific designs of principal airframe components, thus establishing a cost-data base for the study. Cost effectiveness was judged by an analysis that compared direct operating costs and return on investment of the composite and baseline aircraft. A systems operations analysis was performed to judge effects of the smaller, lighter composite aircraft. It was determined that broad applications of advanced composites to the airframe considered could be cost-effective, but this advantage is strongly influenced by structural configuration and several key cost categories. (Author)

A74-38730 # **Improvements in airplane stopping performance on adverse runways.** N. S. Attri and R. L. Amberg (Boeing Commercial Airplane Co., Renton, Wash.). *American Institute of Aeronautics and Astronautics, Aircraft Design, Flight Test and*

Operations Meeting, 6th, Los Angeles, Calif., Aug. 12-14, 1974, Paper 74-965. 7 p.

The basic elements affecting adverse runway stopping performance of modern aircraft are discussed in terms of Pilot Technique, Runway Environment, and Brake Control System. Impact of the various aircraft design decisions and requirements on the basic vehicle parameters is also discussed. Runway surface texture (micro-texture, macro-texture), material and design produce traction variations which must be considered in system development and operation. Pilot technique impacts system design philosophy and airplane operational performance. Final utilization of the available performance is dependent on the total system integration. Advances in braking systems for operation on adverse runways will require better system integration, understanding of environment, and additional tire data. In addition increased emphasis should be placed on improving traction and pilot advisory information. (Author)

A74-38733 # **Suction braking.** T. D. Earl (Bell Aerospace Co., Buffalo, N.Y.). *American Institute of Aeronautics and Astronautics, Aircraft Design, Flight Test and Operations Meeting, 6th, Los Angeles, Calif., Aug. 12-14, 1974, Paper 74-968.* 7 p. 7 refs.

The concept of suction braking is described, and its potential is explained. Model experiments applying the concept to air cushion landing systems and initial manned aircraft experiments using the Bell converted IA-4 are described. The use of suction braking as the total braking system or as a supplementary system is considered. The effect on field length due to greatly improved deceleration capacity and the effect on slippery surface stopping are displayed. In conclusion, the potential gain is related to transport airplane productivity. (Author)

A74-38734 * # **Conceptual design of a lift fan plus lift/cruise fighter aircraft.** G. C. Hill and M. H. Waters (NASA, Ames Research Center, Moffett Field, Calif.). *American Institute of Aeronautics and Astronautics, Aircraft Design, Flight Test and Operations Meeting, 6th, Los Angeles, Calif., Aug. 12-14, 1974, Paper 74-969.* 8 p. 6 refs.

Results of a design synthesis and mission analysis of a supersonic VTOL fighter aircraft are presented. Propulsive lift is provided by a single turbotip-driven lift fan and deflected thrust from a high performance turbofan cruise engine fitted with an afterburner for supersonic flight. The inlet and thrust diverter in the main engine tail-pipe are seen to be the principal design problems. V/STOL and supersonic design tradeoffs are addressed in lift fan sizing and placement, reaction and aerodynamic control sizing, fuselage volume requirements, and area ruling. Range and turn rate are used as figures of merit. (Author)

A74-38735 # **An analysis of the effects of internally blown jet flaps on an advanced fighter aircraft design.** J. L. Parker and R. F. Ball (USAF, Flight Dynamics Laboratory, Wright-Patterson AFB, Ohio). *American Institute of Aeronautics and Astronautics, Aircraft Design, Flight Test and Operations Meeting, 6th, Los Angeles, Calif., Aug. 12-14, 1974, Paper 74-970.* 12 p. 6 refs.

A study has been conducted to determine the effects of internally blown, low momentum blowing coefficient jet flaps on the design of aircraft which have a requirement for transonic maneuverability. In this study the jet flap was applied to conceptual designs of an interdiction and an air-superiority aircraft. Three different bleed locations within the engine were examined as a supply source for the bleed air. The aircraft were resized to include the jet flap performance gains and the weight increase due to the jet flap hardware. In the case of the air-superiority aircraft, the performance gain was insufficient to offset the weight increase and the aircraft grew when the jet flap was added. The reverse was true for the interdiction aircraft, in which case the jet flap both added maneuverability and decreased the aircraft size. (Author)

A74-38736 * # **Supercirculation effects induced by vectoring a partial-span rectangular jet.** F. J. Capone (NASA, Langley Research Center, Hampton, Va.). *American Institute of Aeronautics and Astronautics, Aircraft Design, Flight Test and Operations Meeting, 6th, Los Angeles, Calif., Aug. 12-14, 1974, Paper 74-971.* 9 p. 7 refs.

Thrust-induced supercirculation effects from thrust vectoring have indicated a potential for not only increasing maneuverability of fighter aircraft but also as a means of improving cruise performance. The current study investigated a partial-span rectangular jet-exhaust nozzle located at the wing trailing edge that acts similar to a jet flap by increasing lift due to supercirculation. This paper summarizes experimental studies including the effects of nozzle deflection angle, wing camber, and nozzle shape and exit location on lift, drag and load distributions. The results indicate that significant increases in thrust-induced lift along with substantial decreases in drag are possible. (Author)

A74-38737 # **YC-14 engine installation features.** L. J. Kimes (Boeing Co., Seattle, Wash.). *American Institute of Aeronautics and Astronautics, Aircraft Design, Flight Test and Operations Meeting, 6th, Los Angeles, Calif., Aug. 12-14, 1974, Paper 74-972.* 14 p.

The overwing exhaust engine nacelle for the Air Force/Boeing YC-14 twin engine STOL transport airplane has been developed to apply upper surface blowing powered lift technology to the airplane. The General Electric CF6-50D engine is utilized in a long duct, mixed flow nacelle configuration which features a unique support strut and structure mounted cowling, a simple but effective reverser, and contours designed for low cost fabrication. This paper provides a description of the nacelle and discusses how such key parameters as safety, maintainability, cost restrictions, and weight limitations were integrated with performance parameters into the overall design. (Author)

A74-38738 # **An operational look at the two-segment approach.** J. A. Morrison and R. L. Stimely (United Air Lines, Inc., Denver, Colo.). *American Institute of Aeronautics and Astronautics, Aircraft Design, Flight Test and Operations Meeting, 6th, Los Angeles, Calif., Aug. 12-14, 1974, Paper 74-979.* 9 p.

The development of systems designed to provide two-segment approach guidance for jet transport is discussed. Two systems are described: one using a special purpose computer usable on runways with an instrument landing system (ILS) which includes distance measuring equipment co-located with the glideslope transmitter: the other using an area navigation computer capable of providing guidance to non-instrumented runways as well as those equipped with an ILS. The development of these systems emphasized the safety and operational considerations inherent in the environment of scheduled airline service. (Author)

A74-38740 # **Oil canning of metallic panels in thermal-acoustic environments.** M. J. Jacobson (Northrop Corp., Hawthorne, Calif.) and O. F. Maurer (USAF, Flight Dynamics Laboratory, Wright-Patterson AFB, Ohio). *American Institute of Aeronautics and Astronautics, Aircraft Design, Flight Test and Operations Meeting, 6th, Los Angeles, Calif., Aug. 12-14, 1974, Paper 74-982.* 12 p. 19 refs. Contract No. F33615-72-C-1198.

The overall objective of the investigation being reported was to obtain a better understanding of acoustic fatigue of aircraft panels in thermal environments. Various effects of the thermal-acoustic environments on the panels were investigated, and a new criterion for predicting the oil canning (i.e., dynamic buckling) of skin-rib-stringer type panels in thermal-acoustic environments is presented. The criterion is based on an approximate nonlinear analysis and was verified by acoustic tests of a small number of multibay metallic panels with test temperatures up to 1000F and sound pressure levels at 139 dB and 160 dB. The effects on oil canning of (1) different sequences and (2) simultaneous applications of thermal and acoustic loads were investigated by simulating the acoustic loads with mechanical shaker excitation of simple beam specimens. (Author)

A74-38742 # **Nonlinear effects of spectrum loading on fatigue crack growth in transport wings.** R. B. Sayer (Lockheed-Georgia Co., Marietta, Ga.). *American Institute of Aeronautics and Astronautics, Aircraft Design, Flight Test and Operations Meeting, 6th, Los Angeles, Calif., Aug. 12-14, 1974, Paper 74-984.* 13 p. 11 refs.

Results of a crack growth test program consisting of thirty nine separate tests are presented and discussed in context with the engineering problem of predicting safe life for the wing of a large transport aircraft. Both constant and variable amplitude spectrum loading were utilized. The crack configuration tested was a part-through corner crack emanating from a fastener hole, and fastener loading was included as a test parameter. The major technical problem addressed is that of adequately accounting for the effects of spectrum load level sequence on crack growth, and flight-by-flight spectra were utilized in the test program. The derivation of these spectra is discussed, and it is shown how significantly different spectra can result for the same mission definition, leading to conflicting crack life predictions for the same aircraft usage. (Author)

A74-38743 # **Practical design of minimum weight aircraft structures for strength and flutter requirements.** K. Wilkinson, E. Lerner (Grumman Aerospace Corp., Bethpage, N.Y.), and R. F. Taylor (USAF, Flight Dynamics Laboratory, Wright-Patterson AFB, Ohio). *American Institute of Aeronautics and Astronautics, Aircraft Design, Flight Test and Operations Meeting, 6th, Los Angeles, Calif., Aug. 12-14, 1974, Paper 74-986.* 15 p. 13 refs. Contract No. F33615-72-C-1101.

Several methods for sizing the finite elements of an aircraft structural idealization to achieve minimum-weight design under combined strength and flutter-speed requirements are developed and evaluated. Two basic categories are considered: methods based on a combination of energy principles and optimality criteria, and procedures employing numerical-search techniques. Drawing upon the experience gained from studies of both of these basic methods, a resizing algorithm is developed that employs a uniform-flutter-velocity-derivative optimality criterion for flutter-critical elements and the fully-stressed-design criterion for strength-critical elements. The final result is a practical, automated approach for dealing with large-scale idealizations having both structural and mass-balance design variables. (Author)

A74-38744 * # **Advanced supersonic transport design developments.** C. Driver (NASA, Langley Research Center, Hampton, Va.). *American Institute of Aeronautics and Astronautics, Aircraft Design, Flight Test and Operations Meeting, 6th, Los Angeles, Calif., Aug. 12-14, 1974, Paper 74-987.* 5 p.

Advanced technology studies have indicated a major payload/range improvement for the next generation supersonic transport while meeting stringent environmental requirements. The major technology advance is the variable-cycle engine. When integrated with efficient aerodynamic and structural concepts, the variable-cycle engine airplane will attain a design range of 5500 nautical miles with no penalty for take-off noise or subsonic missions. The goal - not achievable in past programs - will allow one airplane to compete subsonic in over-land sonic boom prohibited areas as well as over-water supersonic routes. This goal will not be achieved without an aggressive technology development program. (Author)

A74-38745 * # **The case for a high-speed research airplane - Results from an in-house study.** F. S. Kirkham, L. R. Jackson, and J. P. Weidner (NASA, Langley Research Center, Hypersonic Vehicles Div., Hampton, Va.). *American Institute of Aeronautics and Astronautics, Aircraft Design, Flight Test and Operations Meeting, 6th, Los Angeles, Calif., Aug. 12-14, 1974, Paper 74-988.* 11 p. 14 refs.

Results of a study aimed at determining the feasibility of developing a single versatile high-speed research airplane (HSRA) which will meet flight research needs of both Mach 3 to 5 JP-fueled military aircraft and of hydrogen-fueled aircraft, both military and civil, for speeds up to Mach 10. The proposed HSRA design concept is an air-launched, rocket-boosted research aircraft designed to accommodate a wide variety of large-scale propulsive and structural flight research experiments. The aircraft is a 60-foot-long discrete wing-body concept with high wings and a center-line vertical tail. Heat sink shields are proposed as an effective and versatile method of achieving low-cost, low-risk thermal protection of the all-aluminum primary structure. A.B.K.

A74-38746 # **Incremental growth vehicle /IGV/.** H. C. Vetter (McDonnell Douglas Astronautics Co., St. Louis, Mo.) and R. W. DeCamp (USAF, Flight Dynamics Laboratory, Wright-Patterson AFB, Ohio). *American Institute of Aeronautics and Astronautics, Aircraft Design, Flight Test and Operations Meeting, 6th, Los Angeles, Calif., Aug. 12-14, 1974, Paper 74-989.* 6 p. Contract No. F33615-73-C-3069.

Description of a manned research vehicle that can be incrementally grown in both its speed capability and its ability to accommodate a spectrum of flight research experiments. Higher-speed airframe capability is achieved by modifying the heat shield, wing, and tails. Experiment versatility is most demanding for thermal protection systems (TPS) and airbreathing propulsion. The former is achieved by a primary structural approach permitting common attachment for a variety of TPS, and the latter by a high wing plus fuselage designed to accept ramjet and scramjet propulsion modules. Size and cost of the vehicle are to be reduced by using an air launch from a B-52 mother ship. A.B.K.

A74-38747 # **Hypersonic research airplane propulsion for boost and test.** V. V. Van Camp and E. T. Williams (Rockwell International Corp., Downey, Calif.). *American Institute of Aeronautics and Astronautics, Aircraft Design, Flight Test and Operations Meeting, 6th, Los Angeles, Calif., Aug. 12-14, 1974, Paper 74-990.* 8 p. 6 refs.

A critical factor in the design of a research airplane capable of obtaining full scale data in the Mach 4 to 10 range is the propulsion system and propellant required for acceleration and for maintaining steady-state test conditions. Typical flight trajectories, test times and propellant requirements are shown for existing test ranges. A vehicle configuration capable of carrying the boost and sustaining propellant and various experiment systems within the constraints of the B52 carrier aircraft is illustrated. The limitations for testing turboramjet and other large diameter airbreathing propulsion systems are discussed. (Author)

A74-38748 # **A review of some Air Force STOL aircraft aerodynamic prediction methods.** H. W. Woolard (USAF, Flight Dynamics Laboratory, Wright-Patterson AFB, Ohio). *American Institute of Aeronautics and Astronautics, Aircraft Design, Flight Test and Operations Meeting, 6th, Los Angeles, Calif., Aug. 12-14, 1974, Paper 74-992.* 14 p. 26 refs.

Two programs dealing with the development of analytical methods for the prediction of the aerodynamic characteristics of STOL aircraft are reviewed in part. The high-lift systems treated are internally blown flaps, externally blown flaps, and mechanical flaps combined with thrust vectoring. Principal emphasis is placed upon describing selected methods that employ rational analytical modeling of the real aerodynamics in conjunction with appropriate empirical modifications. Some limited comparisons with experiment are given, but the main emphasis is on the description of methodology. (Author)

A74-38749 # **Flight performance of a circulation controlled STOL.** J. L. Loth, J. B. Fanucci (West Virginia University, Morgantown, W. Va.), and S. C. Roberts (Flight Research, Inc., State College, Miss.). *American Institute of Aeronautics and Astronautics, Aircraft Design, Flight Test and Operations Meeting, 6th, Los Angeles, Calif., Aug. 12-14, 1974, Paper 74-994.* 9 p. 8 refs. Contract No. N00014-68-A-0512.

Theoretical and wind tunnel studies have been performed on various high lift airfoils using circulation control by blowing over a circular trailing edge. On the basis of these studies, a full scale Technology Demonstrator STOL aircraft was designed, constructed, and flight tested. Circulation control blowing air was provided by bleed air from a gas turbine. The first series of flight tests have recently been completed. Satisfactory STOL performance and handling characteristics were obtained. Advantages of this system are high lift to power ratio, and near level aircraft attitude at all speeds. (Author)

A74-38750 # **Considerations for STOL landing ground rules.** D. J. Renselaer (Rockwell International Corp., Los Angeles, Calif.).

American Institute of Aeronautics and Astronautics, Aircraft Design, Flight Test and Operations Meeting, 6th, Los Angeles, Calif., Aug. 12-14, 1974, Paper 74-996. 13 p. 10 refs.

An analytical investigation indicates the possibility of reducing the landing speed of STOL aircraft by introducing a dual-segment approach. The final segment has a limited maneuver capability and tailwind margin, but has all the necessary safety margins in terms of speed, angle of attack, and load factor. Vertical gusts, tailwind gusts, engine failure, and waveoff were considered. It is proposed to absorb the turning maneuver capability and most of the tailwind capability in the downwind leg in the first segment, which is flown at a higher speed. This speed allows a steep descent flight path with reduced power setting beneficial for noise reduction. (Author)

A74-38751 * # **Microwave landing system requirements for STOL operations.** C. N. Burrous, S. C. Brown, T. Goka, and K. E. Park (NASA, Ames Research Center, Moffett Field, Calif.). *American Institute of Aeronautics and Astronautics, Aircraft Design, Flight Test and Operations Meeting, 6th, Los Angeles, Calif., Aug. 12-14, 1974, Paper 74-997.* 12 p. 14 refs.

The operational/functional requirements for the new Microwave Landing System (MLS) are examined for STOL operations. The study utilizes a nonlinear six-degree-of-freedom simulation of a De Havilland Buffalo C-8A aircraft and automatic flight control system to assess the MLS/STOL accuracy, coverage, and data rate requirements for the azimuth, DME, primary elevation, and flare elevation functions. The aircraft performance is statistically determined for representative curved flight paths through touchdown. A range of MLS errors and coverages, environmental disturbances, and navigation filtering are investigated. The study indicates that STOL applications do not place any unique requirements on the MLS. (Author)

A74-38792 **Netherlands Association of Aeronautical Engineers, Yearbook 1973 (Nederlandse Vereniging voor Luchtvaarttechniek, Jaarboek 1973).** Edited by F. J. Sterk. Amsterdam, Nederlandse Vereniging voor Luchtvaarttechniek, 1974. 85 p. In Dutch and English.

The first paper deals with fighter requirements and developments. Fighters have been transformed from air-to-air combat aircraft into fighter-bombers, and fighter-bombers constitute the backbone of modern tactical air forces. The chairman of the technical committee of OSTIV explains the need for uniform airworthiness for gliders. Infrared techniques and their adaptation to the needs of civil aviation studies are discussed. The Fokker F28 'Fellowship' wind tunnel and flight data are compared. F.R.L.

A74-38793 # **Fighter requirements and developments.** A. Hidma. In: Netherlands Association of Aeronautical Engineers, Yearbook 1973. Amsterdam, Nederlandse Vereniging voor Luchtvaarttechniek, 1974, p. 1-1 to 1-16.

Fighters have been transformed from air-to-air combat aircraft into fighter-bombers. These constitute the backbone of modern tactical air forces today. The complexity of fighter-bombers has reached a point where the development of a new design takes about eight years, provided the design was based upon an existing engine. If the engine has to be developed as well, ten years is nearer the mark. To defend an area the size of a continent against long range jet bombers, an interceptor flying considerably faster than Mach 2 appears attractive, because it can reduce the number of interceptors and airbases required and the airbases may be located further from the borders. Attention is given to improved field performance and improved air-to-air combat performance. F.R.L.

A74-38794 # **International airworthiness requirements for sailplanes (Internationale luchtwaardigheidsvoorschriften voor zweefvliegtuigen).** C. W. A. Oyens (Organisation Scientifique et Technique Internationale du Val à Voile, Schiphol-Centrum, Netherlands). In: Netherlands Association of Aeronautical Engineers, Yearbook 1973. Amsterdam, Nederlandse Vereniging voor Luchtvaarttechniek, 1974, p. 2-1 to 2-11. In Dutch.

The chairman of the technical committee of OSTIV (International Technical and Scientific Organization for Soaring Flight) explains the need for uniform airworthiness requirements for gliders, and the work done by OSTIV in this field. The latest edition of the OSTIV Airworthiness Requirements for Sailplanes is reviewed, and some important points from this document are discussed in detail. The requirements deal with general definitions, flight requirements, structures, design and construction, powered sailplanes, instruments and equipment, and operating limitations. F.R.L.

A74-38796 # **Comparison of Fokker F28 'Fellowship' wind tunnel and flight data - A summary.** J. T. M. van Doorn, S. O. T. H. Han (Nationaal Luchtvaartlaboratorium, Amsterdam, Netherlands), and E. Obert (Fokker-VFW, Schiphol-Oost, Netherlands). In: Netherlands Association of Aeronautical Engineers, Yearbook 1973. Amsterdam, Nederlandse Vereniging voor Luchtvaarttechniek, 1974, p. 5-1 to 5-28.

The ultimate objectives of the comparison were (1) to investigate the differences between the results of the measurements in the high speed wind tunnel (HST) and the low speed wind tunnel (LST) in order to update, if necessary, test procedures and correction methods; (2) to determine the validity of wind tunnel measurements and the accuracy of both tunnels; and (3) to gather more insight in the process of extrapolating wind tunnel test results to flight conditions. The agreement between the results of the LST and HST was rather good. It is noted that the F28, due to the absence of slip stream effects or important areas of separated flow, is an aircraft with fairly linear characteristics. This has to a considerable degree facilitated the extraction of various aerodynamic parameters with relatively simple methods. F.R.L.

A74-38848 **Aerodynamic design of airfoil sections.** K. Ueyama, M. Omura, and T. Tanioka. *Mitsubishi Juko Giho*, vol. 11, no. 2, 1974, p. 1-12. 32 refs. In Japanese, with abstract in English.

Existing airfoil sections are not the most suitable material for aircraft of higher performance, and this has led to the development of methods to design airfoil sections having the required characteristics. As far as the flow around airfoils is subsonic, improved methods have become available to design airfoil sections most suited for the intended purposes, including the effects of boundary layer and compressibility. They have been put to practical use as indispensable tools for achieving high performance. These new methods are outlined and some examples of their application to the development of new types of airfoil sections and cascade blades are given. F.R.L.

A74-38854 **Spectrum of rotor noise caused by atmospheric turbulence.** D. B. Hanson (United Aircraft Corp., Hamilton Standard Div., Windsor Locks, Conn.). *Acoustical Society of America, Journal*, vol. 56, July 1974, p. 110-126. 24 refs. Research supported by the United Aircraft Corp.

The spectra of noise and blade loading caused by interference of a propeller, helicopter rotor, or fan rotor with inlet turbulence are studied experimentally and theoretically. One test with hot-wire anemometers in a static inlet and another test with pressure transducers on the blades of a fan rotor reveal inlet turbulence to be highly anisotropic. The intensity of the transverse velocity component was found to be 2.5% of the mean flow and the streamwise component was 0.9% with ambient winds of about 1 mph. The transverse integral scale of the turbulence is a fraction of an inlet diameter, while the streamwise scale is over 100 diameters. Evidence indicates the source of these disturbances is atmospheric turbulence. The associated noise is partially coherent, with spectrum peaks which are so narrow as to be difficult to distinguish from true harmonics. (Author)

A74-38898 **Aircraft fuel conservation: An AIAA view; Proceedings of a Workshop Conference, Reston, Va., March 13-15, 1974.** Edited by J. Grey. New York, American Institute of Aeronautics and Astronautics, Inc., 1974. 43 p. Members, $4.00; nonmembers, $7.00.

Technical aspects of aircraft fuel conservation are reviewed and discussed, and measures to be taken having the best prospects for short-term and long-term impact are recommended. Fuel conservation is discussed from the viewpoint of aircraft operations, design, propulsion systems, and fuels. Some of the principal measures identified included: increasing load factors, achieved by revised rerouting and scheduling and routing patterns, matching aircraft size to demand, and better matching of total service to the market; research on advanced onboard avionics which will give the pilot sufficient information for him to make real-time selection of fuel-optimum flight profiles and airspeeds; drag reduction by the use of a properly designed small vertical 'winglet' located just inboard of each wingtip; the implementation of supercritical aerodynamic wing designs; increase in frequency and tightening the standards of regular engine maintenance procedures; and modification of hydrocarbon fuels currently used by relaxation of freeze point and flash point specifications and by use of wider fractions and more aromatics. P.T.H.

A74-38908 Reliability and maintainability of aircraft jet engines. I (Fiabilité et maintenabilité sur les réacteurs aéronautiques. I). A. Mihail (Délégation Ministérielle pour l'Armement; Bureau Véritas, Paris, France). *AFCIQ, Bulletin*, vol. 10, June 1974, p. 22-26. In French.

Some statistics are presented showing the decreasing rate of mortal accidents in civil aviation from 1950 to 1973. These statistics are then broken down according to cause of accident, and in the case of mechanical causes, these are broken down into the various mechanical subsystems (motor, hydraulic system, landing equipment, instruments, etc.). The increased reliability of the power plant is demonstrated. Some basic concepts in engine maintenance are briefly described, and some methods of periodic checking of engine condition are indicated, including eddy-current testing, ultrasonic testing, spectrometric oil analysis, and endoscopy. P.T.H.

A74-38930 # A concept for designing transonic blade cascades (O koncepci navrhu transsonickych lopatkovych mrizi). R. Dvorak (Ceskoslovenska Akademie Ved, Ustav Termomechaniky, Prague, Czechoslovakia). *Strojnicky Casopis*, vol. 24, no. 2-3, 1973, p. 135-142. 7 refs. In Czech.

Review of some considerations which led to a basic reorientation of work in the field of transonic blade cascades. A transonic blade cascade has, from the standpoint of a design method, certain features which must be taken into account. First of all, there is the great quantitative and qualitative dependence of transonic flow during small variations in the effective shape of the blades and the strong interrelation between the phenomena in various parts of the interblade channel and along the channel. Then there is the generally very complex path of the sonic line and the shape of the bow shock waves. A number of these phenomena can thus be described easily only by empirical dependences. A formulation of the indirect problem, which would incorporate all the features cited, leads to an analog solution of optimal distributed parameter systems. For its practical realization it is necessary to use numerical methods and boundary conditions in the form of empirical dependences. A.B.K.

A74-39004 Surveillance in flight of aircraft systems (Surveillance en vol des systèmes avion). P. Edouard (Société Nationale Industrielle Aérospatiale, Toulouse, France). In: Onboard computers and their applications; Workshop, Toulouse, France, June 10-12, 1974, Proceedings. Toulouse, France, J. Lagasse, CNRS, Laboratoire d'Automatique et d'Analyse des Systèmes; Privat, Editeur, 1974, p. 211-216. In French.

The conditions of exploitation of modern aircraft and the increasing complexity of their systems involve new concepts of maintenance. The surveillance in flight of the state of the different on-board systems brings a means for solving certain of these problems. The goals of this surveillance are enumerated and the manner of satisfying them is described. Emphasis is placed on the importance of the choice of parameters and on the concept of the signature of breakdown. As a means of illustration of this concept of signature of breakdown the air-fuel exchanger of the Concorde air conditioning system is considered. F.R.L.

A74-39007 Turbomachine numerical control using the ASMODEE 01 prototype (Régulation numérique de turbomachine utilisant le prototype A.S.M.O.D.E.E. 01). M. Brunet, J.-C. Laprie (CNRS, Laboratoire d'Automatique et d'Analyse des Systèmes, Toulouse, France), and C. Beth (Microturbo, S.A., Toulouse, France). In: Onboard computers and their applications; Workshop, Toulouse, France, June 10-12, 1974, Proceedings. Toulouse, France, J. Lagasse, CNRS, Laboratoire d'Automatique et d'Analyse des Systèmes; Privat, Editeur, 1974, p. 243-258. 5 refs. In French.

Description of the design and construction of a numerical control system for a turbomachine consisting of a gas generator and a starter. A detailed account is given of the work carried out in analyzing the turbomachine, developing and refining the control function on the basis of the ASMODEE 01 prototype, and carrying out ground tests and tests at simulated altitude. A.B.K.

A74-39010 Safety objectives of onboard computers on civil aircraft (Objectifs de sécurité des calculateurs numériques embarqués à bord d'avions civils). P. Toulouse (Société Nationale Industrielle Aérospatiale, Toulouse, France). In: Onboard computers and their applications: Workshop, Toulouse, France, June 10-12, 1974, Proceedings. Toulouse, France, J. Lagasse, CNRS, Laboratoire d'Automatique et d'Analyse des Systèmes; Privat, Editeur, 1974, p. 295-304. In French.

Review of some of the preoccupations of the aircraft designer in ensuring credibility of onboard computers. Following a review of the onboard systems of commercial aircraft and a safety analysis based on the probability of nondetection of failure, the notion of credibility of an onboard computer is defined, and the possibility of self-monitoring of the computer performance is discussed. It is concluded that the introduction of onboard computers into nonvital systems poses no particular difficulties, while in the case of vital systems further work is required to ensure the credibility of the computers. A.B.K.

A74-39050 Concorde and safety - Design, testing and certification. R. Chevalier (Société Nationale Industrielle Aérospatiale, Paris, France). *Aeronautical Journal*, vol. 78, June 1974, p. 277-283.

Attention is given to the approaches used to study and demonstrate the safety of the supersonic airliner Concorde. The development of this airliner involved the solution of structure overheating problems. The aircraft structure has to withstand thermal stresses during a period of at least 45,000 hours. A number of separate sections of the Concorde structure were tested to provide data for the design offices and also for certification purposes. Other investigations were related to the study of aircraft systems and flight qualities. The investigations included the development of a method for the systematic research of failure situations. G.R.

A74-39130 # Pollution emission analysis of selected Air Force aircraft. D. F. Naugle (USAF, Weapons Laboratory, Kirtland AFB, N. Mex.). *SAE, AIAA, ASME, ASMA, and AIChE, Intersociety Conference on Environmental Systems, Seattle, Wash., July 29-Aug. 1, 1974, ASME Paper 74-ENAs-30.* 12 p. 9 refs. Members, $1.00; nonmembers, $3.00.

The interest in pollution emissions from aircraft has been enhanced by EPA's recent determination that major civilian airports are significant contributors to localized air quality degradation. This report summarizes the USAF aircraft and engines in common use, presents normalized engine pollution emission factors (emission indices), suggests military landing and takeoff cycle times by aircraft type, and compares aircraft emission inventories for several Air Force bases. (Author)

A74-39198 **An analysis of vibration diagnostics for helicopter power trains.** M. J. Drosjack and D. R. Houser (Ohio State University, Columbus, Ohio). In: Advances in test measurement; Proceedings of the Twentieth International Instrumentation Symposium, Albuquerque, N. Mex., May 21-23, 1974. Volume 11. Pittsburgh, Pa., Instrument Society of America, 1974, p. 219-230. 16 refs.

Evaluation of alternative vibration-signal analysis techniques for use in diagnostic helicopter-maintenance procedures applied to power transmission components linking the helicopter engine to the rotor. The evaluation results include the finding that frequency domain techniques show greater promise than time demain techniques. M.V.E.

A74-39286 * **Automatic numerical generation of body-fitted curvilinear coordinate system for field containing any number of arbitrary two-dimensional bodies.** J. F. Thompson, C. W. Mastin (Mississippi State University, State College, Miss.), and F. C. Thames. *Journal of Computational Physics*, vol. 15, July 1974, p. 299-319. 6 refs. Army-NASA-sponsored research.

A method for automatic numerical generation of a general curvilinear coordinate system with coordinate lines coincident with all boundaries of a general multi-connected region containing any number of arbitrarily shaped bodies is presented. With this procedure the numerical solution of a partial differential system may be done on a fixed rectangular field with a square mesh with no interpolation required regardless of the shape of the physical boundaries, regardless of the spacing of the curvilinear coordinate lines in the physical field, and regardless of the movement of the coordinate system. Numerical solutions for the lifting and nonlifting potential flow about Joukowski and Karman-Trefftz airfoils using this coordinate system generation show excellent comparison with the analytic solutions. The application to fields with multiple bodies is illustrated by a potential flow solution for multiple airfoils. (Author)

A74-39300 **Study of unsteady flows around a pointed airfoil by conformal transformation (Etude par transformation conforme des écoulements instationnaires autour d'un profil à pointe).** R. Roucous and A. Jami (Paris, Université, Laboratoire d'Aérodynamique, Orsay, Essonne, France). *Académie des Sciences (Paris), Comptes Rendus, Série A - Sciences Mathématiques*, vol. 279, no. 1, July 1, 1974, p. 37-40. 5 refs. In French.

On the basis of a technique proposed by Couchet (1956), a new method is presented for the numerical study of an aerodynamic field around a pointed airfoil for any motion through an ideal incompressible fluid, making use of conformal domain transformation. For illustration, comparative results in terms of aerodynamic loads and pressure distributions are given for the flow field about the airfoil in the case of a particular motion. M.V.E.

A74-39344 **Finite element technique in lifting surface problems.** K. Washizu (Tokyo, University, Tokyo, Japan) and M. Ikegawa (Hitachi Co., Ltd., Tokyo, Japan). In: Finite element methods in flow problems; Proceedings of the International Symposium, Swansea, Wales, January 7-11, 1974. Huntsville, Ala., UAH Press, 1974, p. 195-207. 11 refs.

The finite element technique is applied to obtain numerical solutions of integral equations. Two examples are taken from the lifting surface theory of steady aerodynamics. It is shown that numerical results obtained by the finite-element technique are encouraging. Although the examples treated are rather limited, extensions of the present method to other integral equations are straightforward. (Author)

A74-39346 **Analysis of moving body problems in aerodynamics.** T. Bratanow and A. Ecer (Wisconsin, University, Milwaukee, Wis.). In: Finite element methods in flow problems; Proceedings of the International Symposium, Swansea, Wales, January 7-11, 1974. Huntsville, Ala., UAH Press, 1974, p. 225-241. 19 refs.

Details of the mathematical foundation and numerical results of a general finite-element analysis of unsteady incompressible viscous flow around rotating and translating obstacles are presented. The treatment of the nonlinearities in the variational formulation, the method used to account for the time- and space-dependent boundary conditions, boundary layer effects, and the accuracy of the analysis are discussed. Computer graphics results of the unsteady flow variation in terms of streamlines, vorticity distribution, and pressure distribution for Reynolds numbers of 1000 and 100,000 are presented. Advantages of the finite-element and finite-difference methods in the treatment of the problem are also discussed. (Author)

A74-39355 **Flow through a cascade of aerofoils.** D. S. Thompson (Science Research Council, Turbomachinery Laboratory, Cambridge, England). In: Finite element methods in flow problems; Proceedings of the International Symposium, Swansea, Wales, January 7-11, 1974. Huntsville, Ala., UAH Press, 1974, p. 707-720. 20 refs.

Finite element methods are applied to steady incompressible flow in two dimensional cascades of compressor blades. A triangular element is used, with a cubic interpolation for velocity potential or stream function, the unknown quantities being the potential or stream function and the velocities at the nodes. An isoparametric version of this element is described for use at curved boundaries. The results are compared with exact solutions, experimental measurements and other numerical methods. (Author)

A74-39372 # **Supersonic combustion ramjets.** G. L. Dugger and F. S. Billig (Johns Hopkins University, Baltimore, Md.). *AIAA Student Journal*, vol. 11, Dec. 1973, p. 8-12. 8 refs.

It is pointed out that for hypersonic flight within the earth's atmosphere the supersonic combustion ramjet or 'scramjet' is superior to all other engines. The reasons for the scramjet's superiority to the turbojet and the conventional ramjet at hypersonic speeds are considered and the merits of prospective fuels are discussed. Hydrogen is well suited for hypersonic aircraft if the problems of cryogenic liquid storage and low fuel density can be solved. Storable liquid boranes are attractive for use in missiles. The historical background of scramjets is briefly reviewed and the future prospects for scramjets are examined. G.R.

A74-39381 # **Inside the 747.** B. C. Stephens (Boeing Commercial Airplane Co., Seattle, Wash.). *AIAA Student Journal*, vol. 12, Feb. 1974, p. 10-17, 27, 47.

Discussion of the Boeing 747 as a complex organization of structure, accommodations and systems directed to meet certain major operational criteria, including 385 and baggage over 5000 NM, 200,000 lb containerized cargo over 3500 NM, cruise speed higher than that of available jets, community noise improvement, increased safety level through system redundancy, 97% schedule reliability, and 60,000 fatigue life. The development of the Boeing 747 is reviewed by stages. Technological, economic, air traffic aspects, safety, and comfort aspects are covered. V.Z.

A74-39418 # **The Viper turbojet engines. I (Turbinowe silniki odrzutowe Viper. I).** W. Kordzinski. *Technika Lotnicza i Astronautyczna*, vol. 29, June 1974, p. 9-16. In Polish.

The Rolls-Royce Viper turbojet engines, providing thrust levels from 1134 to 1815 kg, are currently one of the most prevalent types of power plant used in trainer, light attack, and business aircraft. The popularity of these engines stems from low production costs, easy maintenance, high reliability, and long periods of operation between repairs. These qualities are the result of continuous, prolonged improvement that stressed retention of maximum design simplicity. The article traces the evolution and development of Viper engines starting from 1948, describing successive changes which raised the thrust capability from an initial 744 kg to the 1815 kg at present. T.M.

A74-39472 # **3-D energy management for supersonic aircraft.** H. J. Kelley (Analytical Mechanics Associates, Inc., Jericho, N.Y.). *IFAC, IIC, and ANIPLA, Symposium on Automatic Control in Space, 5th, Genoa, Italy, June 4-8, 1973, Paper.* 16 p. 15 refs.

Turn-dash-turn and turn-cruise-turn approximations to optimal 3-D aircraft flight paths are studied on the basis of asymptotic expansions. Modeling assumptions and constraints are discussed, and some computational results presented. Possibilities for using families of pre-computed control commands in flight are examined. (Author)

A74-39485 # Performance bound of an aircraft lateral control system using the microwave scanning beam landing system. M. Desai (Charles Stark Draper Laboratory, Inc., Cambridge, Mass.) and D. MacKinnon (U.S. Department of Transportation, Control Technology Div., Washington, D.C.). *IFAC, IIC, and ANIPLA, Symposium on Automatic Control in Space, 5th, Genoa, Italy, June 4-8, 1973, Paper.* 18 p. 5 refs. U.S. Department of Transportation Contract No. TSC-91.

The scanning beam microwave landing system has been recommended by RTCA SC117 to upgrade and eventually replace the present VHF instrument landing system. The exploration of the effect of MLS scan-rate and signal noise on the performance of the flight path control system is a significant requirement for the specification of the MLS signal requirements. This paper utilizes a parameter optimization technique to investigate impact of scan rate and sensor noise on the performance limits for an MLS-based lateral path control system for a jet transport aircraft operating in a stochastic environment of wind gusts and MLS signal noise. (Author)

A74-39495 # On-line two-level gust alleviation control system for aircraft in an unknown environment. P. N. Nikiforuk, M. M. Gupta (Saskatchewan, University, Saskatoon, Canada), and K. Kanai. *IFAC, IIC, and ANIPLA, Symposium on Automatic Control in Space, 5th, Genoa, Italy, June 4-8, 1973, Paper.* 25 p. 9 refs. National Research Council of Canada Grants No. A-5625; No. A-1080; Defence Research Board of Canada Grants No. 4003-02; No. 9781-04.

Consideration of the design of a gust alleviation control system which can cope with the instabilities that occur in the lateral motion of a modern high-speed aircraft subjected to gusts. The stability boundaries of two typical aircraft subjected to a sinusoidal longitudinal gust are derived by a successive approximation method. These stability boundaries are then verified using analog simulation. A gust alleviation control system using a two-level control structure is derived. The technique employs the Liapunov signal synthesis procedure which essentially bypasses the requirements for plant identification and state-variable measurements as required by modern control theory. This procedure also permits relatively rapid design with inherent overall stability of the system, and the assurance of certain desired response characteristics of the aircraft. Furthermore, it does not require a high-order dynamic controller, as would be needed in the conventional model-reference adaptive technique or in optimal control theory. A.B.K.

A74-39496 * # Application of modern control theory to the design of optimum aircraft controllers. L. J. Power (NASA, Ames Research Center, Moffett Field, Calif.). *IFAC, IIC, and ANIPLA, Symposium on Automatic Control in Space, 5th, Genoa, Italy, June 4-8, 1973, Paper.* 11 p. 5 refs.

A procedure is described for synthesis of optimal aircraft control systems by application of the concepts of optimal control theory to time-invariant linear systems with quadratic performance criteria. Essential in this synthesis procedure is the solution of the Riccati matrix equation which results in a constant linear feedback control law for an output regulator which maintains a plant in an equilibrium in the presence of impulse disturbances. An algorithm is derived for designing maneuverable output regulators with selected state variables for feedback. V.Z.

A74-39499 # Automation and flight management in commercial aviation. J. Rabary (Compagnie Nationale Air France, Paris, France). *IFAC, IIC, and ANIPLA, Symposium on Automatic Control in Space, 5th, Genoa, Italy, June 4-8, 1973, Paper.* 11 p.

As with any repetitive activity involving processes for which satisfactory mathematical models can be made, flight operations in commercial aviation are inevitably going to lead to a large use of automation. This is to achieve safety and financial management. Major attention is given to SST operations, air traffic management, and operations program simulation. It is considered that the way to success for automation in this field is an open minded system analysis concept. Owing to the wide scope covered by the various problems, automation is a condition for good financial management, usefulness, and even the existence of air transport. F.R.L.

A74-39520 # Automatisms in supersonic transport. M. J. Pelegrin. *IFAC, IIC, and ANIPLA, Symposium on Automatic Control in Space, 5th, Genoa, Italy, June 4-8, 1973, Paper.* 36 p.

Discussion of the various supersonic transport automatic control systems, covering collision avoidance systems, passenger comfort equipment, clear air turbulence detection systems, microwave landing systems, stability and maneuverability control systems, propulsion control, and air conditioning. Mode specifications for automatic pilot, automatic throttle, and automatic director are also included. V.Z.

A74-39648 A study of high temperature fuels and lubricants on supersonic aircraft/engine system performance. T. E. Russell (General Electric Co., New York, N.Y.) and R. E. Mattes (McDonnell Aircraft Co., St. Louis, Mo.). *Society of Automotive Engineers, Air Transportation Meeting, Dallas, Tex., Apr. 30-May 2, 1974, Paper 740473.* 11 p. Members, $1.40; nonmembers, $2.25.

A74-39649 Opportunities in flight/propulsion control coupling /FPCC/. E. Rachovitsky (USAF, Flight Dynamics Laboratory, Wright-Patterson AFB, Ohio). *Society of Automotive Engineers, Air Transportation Meeting, Dallas, Tex., Apr. 30-May 2, 1974, Paper 740482.* 6 p. 6 refs. Members, $1.40; nonmembers, $2.25.

Flight/propulsion control coupling (FPCC) is a flight control technique which couples propulsive forces with aerodynamic forces to affect the flight path and/or flight stability. FPCC is a powerful technique for enhancing and/or enabling performance of advanced airborne vehicles. An overview of the problem of developing the FPCC technology is presented to illuminate some of its key overall requirements. A need for a total system/total mission approach is indicated. (Author)

A74-39650 Powered lift for longer field lengths and longer missions. H. R. Leslie and J. A. Bennett (Lockheed-Georgia Co., Marietta, Ga.). *Society of Automotive Engineers, Air Transportation Meeting, Dallas, Tex., Apr. 30-May 2, 1974, Paper 740502.* 9 p. Members, $1.40; nonmembers, $2.25.

It is hypothesized that the potential value of powered lift may be greater for transport applications requiring RTOL and CTOL field lengths than for those requiring STOL performance. Thus, it is implied that powered lift can be applied effectively to aircraft designed for medium and long haul, as well as short haul. This premise has been reached on the basis of observed trends in direct operating cost, mission fuel consumption, and, most significantly, community noise footprint areas for both powered lift and conventional mechanical flap configurations. Some pertinent results from recent NASA-sponsored configuration design and system studies for quiet short haul and fuel-conservative aircraft are discussed, and further data are developed to explore the potential value of incorporating powered lift concepts in advanced aircraft designs for medium- and long-haul applications. (Author)

A74-39664 Functional command/control considerations for ship-deployable tactical remotely-piloted vehicle /RPV/. R. E. Wehman (U.S. Naval Material Command, Naval Weapons Laboratory, Dahlgren, Va.). In: International Conference on Communications, 10th, Minneapolis, Minn., June 17-19, 1974, Conference Record. New York, Institute of Electrical and Electronics Engineers, Inc., 1974, p. 10B-1 to 10B-4.

Examination of the technical requirements for effective and secure command/control/communications data links to and from a proposed ship-deployable remotely-piloted vehicle adaptable for use in tactical reconnaissance and/or targeting missions. Particular emphasis is given to two critical areas demanding higher performance capability than that afforded by current operational systems: (1) line-of-sight navigational tracking for extended ranges up to 100 miles over water under constantly-changing sea conditions; and (2) electronic countermeasures security of up and down links. (Author)

A74-39739 # **Jet engine noise testing.** T. N. Cokenias (FAA, Washington, D.C.). In: National Conference on Environmental Effects on Aircraft and Propulsion Systems, 11th, Trenton, N.J., May 21-23, 1974, Proceedings. Trenton, N.J., U.S. Naval Air Propulsion Test Center, 1974. 22 p. 7 refs.

Noise testing of the engine on the ground is performed to ensure aircraft compliance with noise regulations. A review of basic acoustic principles is presented, giving attention to the characteristics of sound waves, the response of the ear to acoustic energy intensity, the dB levels of sound encountered under various conditions, the outdoor propagation of sound waves, and questions of human sound perception. Aspects of psychoacoustics are also examined. An example of jet engine testing is considered, taking into account a plot plan of the test facility, the jet engine test stand, and the acoustic data system. G.R.

A74-39740 # **Static noise measurement of full scale jet engines.** M. P. McMahon (United Aircraft Corp., Pratt and Whitney Aircraft Div., East Hartford, Conn.). In: National Conference on Environmental Effects on Aircraft and Propulsion Systems, 11th, Trenton, N.J., May 21-23, 1974, Proceedings.
Trenton, N.J., U.S. Naval Air Propulsion Test Center, 1974. 13 p.

Continuing efforts to develop and improve low noise aircraft powerplant systems, particularly for commercial aviation applications, have placed an ever increasing emphasis on the need for reliable static engine noise testing capabilities. Extensive noise test programs have been conducted in support of current high bypass ratio engine development, producing a considerable background of testing experience which has implemented the incorporation of significant improvements in testing procedures and the facilities used. This paper reviews these testing procedures and the measurement techniques employed during full scale engine noise tests and describes a large outdoor noise test facility which has recently undergone extensive modification and improvement. (Author)

A74-39741 # **Aircraft avionics environmental control analysis procedures for optimized life cycle cost.** B. T. Plizak (U.S. Naval Material Command, Naval Air Development Center, Warminster, Pa.), S. A. Campbell, and K. J. Taylor (General Dynamics Corp., Convair Aerospace Div., San Diego, Calif.). In: National Conference on Environmental Effects on Aircraft and Propulsion Systems, 11th, Trenton, N.J., May 21-23, 1974, Proceedings. Trenton, N.J., U.S. Naval Air Propulsion Test Center, 1974. 18 p. 9 refs. Navy-supported research.

The cost analysis procedures considered are concerned with the life cycle cost advantages of the various environmental control systems. These procedures can, therefore, be used to optimize the environmental control systems around life cycle cost. Examples of a use of the procedures for a fighter and an ASW aircraft are discussed. It is found that in both cases considerable cost savings can be realized by utilizing constant temperature avionics. G.R.

A74-39742 # **Test techniques and equipment for the development of aircraft engine components resistant to bird ingestion.** R. F. French (General Electric Co., Aircraft Engine Group, West Lynn, Mass.). In: National Conference on Environmental Effects on Aircraft and Propulsion Systems, 11th, Trenton, N.J., May 21-23, 1974, Proceedings. Trenton, N.J., U.S. Naval Air Propulsion Test Center, 1974. 20 p.

Bird ingestion testing starts in the early design phase of an aircraft and continues through demonstration testing on complete engines. All bird ingestion testing involves striking the test part with a bird or simulated bird with a high relative velocity. In the bench test, this is accomplished by mounting the test part stationary and striking it with a bird shot from a gas gun. In the rotating tests, the bird is either inserted in the path of the rotating blade or shot from the gas gun at the rotating blades. Details of various test facilities are discussed. G.R.

A74-39749 # **Evaluating and controlling erosion in aircraft turbine engines.** J. E. Newhart (U.S. Naval Air Propulsion Test Center, Trenton, N.J.). In: National Conference on Environmental Effects on Aircraft and Propulsion Systems, 11th, Trenton, N.J., May 21-23, 1974, Proceedings. Trenton, N.J., U.S. Naval Air Propulsion Test Center, 1974. 14 p. 6 refs.

It is pointed out that high velocity impact of solid particles, such as sand or dust, can cause significant erosion damage to aircraft propulsion components. One approach to deal with this problem makes use of a filtration system which will remove most of the solid particles from the air stream. Another approach is based on the use of blading materials which are not appreciably affected by solid particle erosion. Approaches for blading protection are also employed. Erosion studies involving turbines operating in dusty environments are discussed along with the development of an erosion resistant coating and aspects of erosion testing. G.R.

A74-39768 Testing of commercial airplane environmental control systems. *SAE Aerospace Recommended Practice,* ARP 217 B, Oct. 15, 1973. 8 p.

These recommendations are written to cover the testing of environmental control equipment, functioning as a complete and installed system for the purpose of demonstrating the safety, proper functioning, and performance of the installation and equipment, and obtaining data for future design and to aid in the analysis of in-service performance of the system and equipment. The testing includes the following areas related to the aircraft environmental control system: sources of heat, sources of fresh air and/or ventilation, the refrigeration systems, the heat sinks, distribution systems including ducting, joints, etc, water separation and anti-ice controls, exhaust systems, temperature control systems, and cabin and compartment pressurization systems including flow and pressure controls. F.R.L.

A74-39867 * # **Evaluation of spoilers for light aircraft flight path control.** D. L. Kohlman (Kansas, University, Lawrence, Kan.) and C. H. Brainerd (Northrop Services, Inc., Huntsville, Ala.). *Journal of Aircraft,* vol. 11, Aug. 1974, p. 449-456. 12 refs. Grant No. NGR-17-002-072.

A fixed-base flight simulator was used to evaluate wing spoilers for longitudinal flight path control on a modified Cessna 177B aircraft. More than 100 simulated ILS approaches were flown by evaluation pilots using both conventional methods and spoiler controls. Three different spoiler control methods were evaluated. Spoilers provided precise glide path control with constant airspeed and attitude. Control is most effective when the steady-state trimmed aircraft lift coefficient remains independent of spoiler position. (Author)

A74-39876 * **Weight estimates for Quiet/STOL aircraft.** R. W. Patterson (Lockheed-Georgia Co., Marietta, Ga.). *Society of Allied Weight Engineers, Annual Conference, 33rd, Fort Worth, Tex., May 6-8, 1974, Paper 1001.* 79 p. Contracts No. NAS2-6761; No. NAS2-7300; No. NAS2-6995.

Attention is drawn to the dependence of Q/STOL weight estimation relationships on design acoustic level, engine selection, high-lift concept, design criteria such as field lengths, range, speed and payload, aircraft geometry, and design constraints such as vehicle cost and fuel prices. Weight estimate considerations with associated configuration and design details are presented. Typical weight estimating relationships being used in a NASA study contract are also included. Some representative future applications of Q/STOL concepts are visualized as (1) fuel conservative configurations utilizing

STOL high-life concepts for obtaining relatively higher wing loadings during cruise, and (2) low-wing loading aircraft configurations with short-range, low-passenger capacity, and low fan-passenger-ratio turbo-fan engines for a future interurban air transportation market. V.Z.

A74-39877 **Methodologies for predicting avionic system capability and weight in CTOL and VTOL fighter/attack aircraft 1975 to 1995.** W. A. Falkenstein (LTV Aerospace Corp., Dallas, Tex.). *Society of Allied Weight Engineers, Annual Conference, 33rd, Fort Worth, Tex., May 6-8, 1974, Paper 1002.* 37 p.

Advances and trends of electronic circuit technology are considered together with developments in avionic systems technology. Relationships are established for the application of the technological advances to system design and performance analysis of future aircraft in the time period from 1975 to 1995. One prediction methodology is developed for estimating avionic system weight and another for estimating avionic system capability. The first methodology is shown applicable to vertical takeoff and landing fighter/attack aircraft whereas the second is applicable to conventional takeoff and landing aircraft. It is found that the 1750 pound 1970 technology system can be expected to increase in functional complexity nearly three times by 1985. G.R.

A74-39878 **Weight control and how we look at it.** E. Schneider and H.-J. Mader. *Society of Allied Weight Engineers, Annual Conference, 33rd, Fort Worth, Tex., May 6-8, 1974, Paper 1004.* 35 p.

The Weight Control Department has the task of meeting projected aircraft weights during the development and production phases. In the case of absolutely necessary weight increases resulting from tests (static, dynamic, flight testing), equipment modifications, or additional customer requirements, the department has to ensure that these additional weights remain as low as possible. In view of this task, it is absolutely necessary that the Weight Control Department (1) begins right at the project phase to play an active part in development, and (2) makes full use of its organizational authority during the development and production phases. Experience to date has shown that phase I (project, definition, and pre-design phase) is most important, as the basic decisions on the aircraft design are made during this time. F.R.L.

A74-39880 **The C-5 weight control program and its influence on structural efficiency.** J. Delbridge (Lockheed-Georgia Co., Marietta, Ga.). *Society of Allied Weight Engineers, Annual Conference, 33rd, Fort Worth, Tex., May 6-8, 1974, Paper 1008.* 19 p.

Discussion of the originating circumstances, implementation practices and costs, and structural efficiency results of the C-5 aircraft weight control program. The existence of contractual weight and performance guarantees, the incorporation of precontractual configuration changes required for performance improvement, and the incorporation of postcontractual configuration changes required to meet performance guarantees are shown to have brought about the need for a stringent C-5 weight control program. Examples are given of the expenditures made to control weight and some of the difficulties encountered. Highlights of the program are presented with emphasis on analysis and design practices which influenced structural efficiency. M.V.E.

A74-39885 **Preliminary weight estimation of canard configured aircraft.** J. Banks (LTV Aerospace Corp., Dallas, Tex.). *Society of Allied Weight Engineers, Annual Conference, 33rd, Fort Worth, Tex., May 6-8, 1974, Paper 1015.* 18 p. 7 refs.

A method is developed for preliminary estimation of canard influence on surfaces and fuselage weight. It is specifically intended for integration into the semi-analytic weight estimation methods used by Vought and is based on a mathematical model determined by correlating wind tunnel test results with aerodynamic theory. As such, it represents an intermediate step between design initiation and advanced design evaluation. Development of the basic theory and correlation of test data are described, canard and wing load distributions and fuselage effects are gone over. For lack of data in the transonic region, a linear variation between the subsonic and low supersonic cases was assumed. A numerical example is included. J.K.K.

A74-39886 **'SWEEP' - An interdisciplinary approach to a structure weight estimating program.** T. A. Meledy (Rockwell International Corp., Los Angeles, Calif.). *Society of Allied Weight Engineers, Annual Conference, 33rd, Fort Worth, Tex., May 6-8, 1974, Paper 1016.* 26 p. Research supported by the Rockwell International Independent Research and Development Funds and U.S. Air Force.

SWEEP (structural weight estimation program) is described, with emphasis on the interdisciplinary considerations with the many options that give the user a very versatile tool. SWEEP is a highly sophisticated modular-type program with major engineering analysis modules structured around preliminary design procedures and integrated into a working program that can completely analyze structure weights and mass properties of major vehicle components. The basis for the structural weight analysis in SWEEP is the close approximation of the procedures and methods used in the actual structural analysis and design processes through the creation of an engineering description of the components in terms of physical geometries, design criteria, structural sizings, and mass properties. F.R.L.

A74-39887 **A method for weight/cost trade-offs in preliminary air vehicle design.** A. Krzyzanowski (Teledyne Ryan Aeronautical, San Diego, Calif.). *Society of Allied Weight Engineers, Annual Conference, 33rd, Fort Worth, Tex., May 6-8, 1974, Paper 1017.* 42 p. USAF-sponsored research.

A simplified method for preliminary weight/cost trade-offs is presented. Wing and fuselage weighted models are established and compared to a baseline configuration. Gross weight, load factors, wing geometry, outboard stores and fuselage volume determine the models. Relative values of weight and cost factors allow a comparison between different material utilization and structural configurations. Plots of cost versus weight are used to arrive at decisions for preliminary structural design. Examples of wing and fuselage structural weight and cost matrices are presented. (Author)

A74-39888 **Fly-by-wire - What does it weigh.** G. E. Ross (McDonnell Aircraft Co., St. Louis, Mo.). *Society of Allied Weight Engineers, Annual Conference, 33rd, Fort Worth, Tex., May 6-8, 1974, Paper 1018.* 17 p. USAF-sponsored research.

An evaluation is made of the weight of fly-by-wire (FBW) flight control systems for advanced fighter aircraft. The evolution of flight control system weight is traced from a manual system through varying levels of hydraulic boost and augmented power controls, to complete FBW. Projected weight trends of future control systems reveal the possibility of achieving a lighter flight control system. (Author)

A74-39889 **Fuselage basic shell weight prediction.** R. N. Staton (LTV Aerospace Corp., Dallas, Tex.). *Society of Allied Weight Engineers, Annual Conference, 33rd, Fort Worth, Tex., May 6-8, 1974, Paper 1019.* 52 p. 5 refs.

This paper presents a method for prediction of basic fuselage shell weight intended for use in a weight penalty estimation technique. Consideration is given to internal loading based on the applied shear and bending loads and minimum gauge requirements. Expressions for internal loading are developed that are used in conjunction with test data to determine section sizing. Methods for description of cross sections in terms of conic segments and techniques for accountability of material and temperature variation are also given. The method is intended for use as a computerized analysis tool and the appendicies contain a Fortran source listing, output description and input requirements of a routine written for application of the method as presented. Application of this method at VSD has been primarily for fighter/attack aircraft but extension to other aircraft categories should require only minor modification. The method was developed for use in advanced design studies and is not intended for use in a detailed design application. (Author)

A74-39891 * **A parametric analysis of transport aircraft system weights and costs.** J. L. Anderson (NASA, Ames Research Center, Moffett Field, Calif.). *Society of Allied Weight Engineers, Annual Conference, 33rd, Fort Worth, Tex., May 6-8, 1974, Paper 1024.* 16 p.

In determining unit and operating costs for advanced aircraft, it has been found that by having first-order weight and performance approximations for the aircraft systems and structural components, a step increase in cost prediction accuracy results. This paper presents first-order approximation equations for these systems and components. These equations were developed from data for most current jet transports, and they have been ordered to use a minimum number of performance parameters such as aircraft style, number of passengers, empty and gross weight, cargo load, and operating range. A NASA Ames Research Center aircraft cost program has been used to compare calculated and actual weights for the same aircraft. Good aircraft cost correlation is shown to exist between calculated first-order and actual aircraft weight data. (Author)

A74-39898 # **Advanced tooling techniques using a thermoplastic compound.** A. R. Gomez (Douglas Aircraft Co., Long Beach, Calif.). In: The wide world of plastic tooling; Proceedings of the Eighth Annual Western Plastics for Tooling Conference, San Diego, Calif., April 3-6, 1974. Conference sponsored by the Society of the Plastics Industry and San Diego State University. North Hollywood, Calif., Western Periodicals Co., 1974, p. 37-43.

Description of the manufacturing applications and properties of a thermoplastic tooling compound, called 'Rigidax'. It is shown to be very useful in providing temporary milling tools for machining odd-shaped parts. The support provided by this material during critical machining of thin-walled parts reduces man-hour requirements. M.V.E.

A74-39902 **Carbon fibres can be cost-competitive - An example.** G. Lubin and S. Dastin (Grumman Aerospace Corp., Bethpage, N.Y.). *Plastics Institute, International Conference on Carbon Fibres, their Place in Modern Technology, London, England, Feb. 18-20, 1974, Paper.* 11 p.

Preliminary testing and evaluation of a set of carbon/epoxy composites resulted in the selection of a combination of Hercules 3002 epoxy resin and Hercules Type A fiber as a candidate material for aircraft structural components. This material exhibited the best combination of high-strength properties and low cost. The following systems are earmarked as qualified for future carbon/epoxy applications: Narmco 5208 resin with Union Carbide T-300 fiber and Hercules 3501 resin with Hercules Type A fiber. V.Z.

A74-39910 **Application of carbon fibers to helicopters.** R. L. Pinckney (Boeing Vertol Co., Philadelphia, Pa.). *Plastics Institute, International Conference on Carbon Fibres, their Place in Modern Technology, London, England, Feb. 18-20, 1974, Paper.* 4 p. 5 refs.

Exploratory work on carbon fiber applications in helicopter structural components shows that even though carbon fibers exhibit very high specific strength, and stiffness, their brittle failure characteristics, their current cost and insufficient knowledge of their long term performance discourage their commercial use in helicopters. Other factors affecting adversely the progress in this field include low-velocity impact damage, long-term environmental degradation, possible electrolytic and galvanic reactions between carbon fiber and metallic components, and high-voltage damage. V.Z.

A74-39965 # **The CF6-6 engine - The first million hours.** P. C. Setze (General Electric Co., Aircraft Engine Group, West Lynn, Mass.). In: International Symposium on Air Breathing Engines, 2nd, Sheffield, England, March 24-29, 1974, Proceedings. London, Royal Aeronautical Society, 1974. 14 p.

Review of the history and performance of the high by-pass ratio turbofan CF6-6 engine from its initial conceptual stages through the first one million hours of commercial airline service. It is shown that the performance of this engine has met the expectations of both the manufacturers and users. Component improvement programs currently in progress are expected to improve further the fuel consumption margin. M.V.E.

A74-39967 # **Performance problems related to installation of future engines in both subsonic and supersonic transport aircraft.** W. C. Swan (Boeing Commercial Airplane Co., Renton, Wash.). In: International Symposium on Air Breathing Engines, 2nd, Sheffield, England, March 24-29, 1974, Proceedings. London, Royal Aeronautical Society, 1974. 15 p.

Review of some concepts of variable-cycle engines, and discussion of their potential for improvements or refinements of multimission aircraft. The application of variable-cycle engines to supersonic aircraft and to noise-sensitive STOL aircraft is considered to illustrate the potential for performance improvements achievable with such engines. Several alternative concepts of variable-cycle engine configurations, which should be investigated to define the benefits to such aircraft, are described. It is shown that the noise near airport boundaries may be significantly reduced through an alternate engine cycle on landing and takeoff, and that outstanding solutions to problems of aircraft center-of-lift control on V/STOL aircraft may be provided. M.V.E.

A74-39968 # **Feederliner engine installation - Trends and problems.** D. H. Tipper (Hawker Siddeley Aviation, Ltd., Hatfield, Herts., England). In: International Symposium on Air Breathing Engines, 2nd, Sheffield, England, March 24-29, 1974, Proceedings. London, Royal Aeronautical Society, 1974. 13 p.

Discussion of the power-plant features whose development is made desirable by the service circumstances of turbofan-powered feeder airliners operating between small-town airfields and big international airports. These features include substantially lower idling thrust and higher bleed airflow percentages than are possible at present. M.V.E.

A74-39970 # **The use of a rotating arm facility to study flight effects on jet noise.** W. Smith (Rolls-Royce /1971/, Ltd., Bristol, England). In: International Symposium on Air Breathing Engines, 2nd, Sheffield, England, March 24-29, 1974, Proceedings. London, Royal Aeronautical Society, 1974. 13 p.

Description of the design, instrumentation, and operation of a rotating arm facility for the study of flight effects on jet noise, and review of the capabilities and limitations of the facility. Noise data acquisition and analysis techniques are outlined, and the results obtained from recent tests are shown to indicate the repeatability and accuracy of the data. M.V.E.

A74-39971 # **Life enhancement of turbine blades.** R. V. N. Murthy (Purdue University, Lafayette, Ind.). In: International Symposium on Air Breathing Engines, 2nd, Sheffield, England, March 24-29, 1974, Proceedings. London, Royal Aeronautical Society, 1974. 10 p.

Description of a theoretical and experimental investigation that led to the reassessment of the life expectancy of Nimonic-90 aircraft turbine blades and resulted in an overhaul-life extension from 250 to 300 hours for standard-version engines and to 550 hours for engines of a derated version without jeopardy to airworthiness. All engines that have completed the extended service life have done so without any trouble, and no engine had to be withdrawn for failure of turbine blades. M.V.E.

A74-39980 # **Three-dimensional wave interactions in supersonic intakes.** R. K. Nangia (British Aircraft Corp., Ltd., Bristol, England). In: International Symposium on Air Breathing Engines, 2nd, Sheffield, England, March 24-29, 1974, Proceedings. London, Royal Aeronautical Society, 1974. 18 p. 13 refs. Research supported by the National Gas Turbine Establishment, Aircraft Research Association, and British Aircraft Corp.

This paper presents the results of an experimental program designed to give better understanding of the simpler type of intake

interactive flows. Models simulating free edge and corner flows were tested. The studies included fully compressive, 'mixed' expansive-compressive, and fully expansive interaction flows. The interference wave structure was defined with the aid of surface statics and multitube pitot pressure rake measurements. The application of this work to the design of air intakes for supersonic aircraft is discussed. (Author)

A74-39981 # **Mixed compression air intakes for operation at Mach 2.2.** A. J. Brooks and G. J. Dadd (National Gas Turbine Establishment, Farnborough, Hants., England). In: International Symposium on Air Breathing Engines, 2nd, Sheffield, England, March 24-29, 1974, Proceedings. London, Royal Aeronautical Society, 1974. 16 p.

Model tests on a series of mixed compression intakes, at conditions equivalent to Mach 2.2 flight, led to the development of an intake bleed arrangement which permitted continuous operation over an adequate mass flow range and with acceptable engine flow distortion levels. An analysis method was developed for comparing intakes in terms of their effects on payload. This was used to demonstrate a payload performance improvement of 5.5% for the best model tested, relative to typical external compression intakes, with a potential for a further 2% improvement following further development. (Author)

A74-39983 # **Contribution to the study of noise from jet aircraft during flight (Contribution à l'étude du bruit de jets en vol).** G. Richter and C. Schmidt (SNECMA, Paris, France). In: International Symposium on Air Breathing Engines, 2nd, Sheffield, England, March 24-29, 1974, Proceedings. London, Royal Aeronautical Society, 1974. 13 p. 14 refs. In French.

Experimental study of the effects of flight velocity on jet noise sources in terms of jet turbulence and sound-emission direction. A jet nozzle model was used in a wind tunnel where flight motion was simulated by a secondary flow around the jet. The validity of the results is verified by comparisons with other experimental data. M.V.E.

A74-39987 # **Dynamic flow distortion in subsonic air inlets.** J. R. Jones and W. M. Douglass (Douglas Aircraft Co., Long Beach, Calif.). In: International Symposium on Air Breathing Engines, 2nd, Sheffield, England, March 24-29, 1974, Proceedings. London, Royal Aeronautical Society, 1974. 13 p.

Subsonic-transport engine air inlets were tested in a wind tunnel to measure performance during static operation with cross wind. The models were instrumented so that fluctuating pressure could be measured in addition to steady-state pressures. The principal instrumentation consisted of 36 fluctuating and steady-state total-pressure probes at the end of the inlet. It was determined that fluctuating pressure data are necessary to detect inlet boundary-layer separations when the separations are intermittent. Also, comparison of steady-state and time-dependent 'instantaneous' total-pressure distributions at the end of the inlet showed that the maximum total-pressure losses were two to four times as large as those indicated by the steady-state data, and that the maximum extent of the low total-pressure regions was much larger than that indicated by the steady-state data. (Author)

A74-39989 # **Some aerodynamic design considerations for high bypass ratio fans.** L. H. Smith, Jr. (General Electric Co., Group Engineering Div., Cincinnati, Ohio). In: International Symposium on Air Breathing Engines, 2nd, Sheffield, England, March 24-29, 1974, Proceedings. London, Royal Aeronautical Society, 1974. 14 p. 5 refs.

For some applications, such as the General Electric CF6-6 engine, it is desired to bring the hub energy level up to that of the tip in the fan component through the use of a tandem part-span stage called a quarter stage. The optimum design of such an arrangement involves consideration of special aerodynamic design features and phenomena such as secondary flows due to nonconstant blade circulations, diffusion of nonuniform flows, and employment of stator vanes with significant sweep and dihedral. The manner in which these concepts were applied in the design of the CF6-6 fan are discussed, and it is concluded that the employment of the classical aerodynamic design approach to an unusual arrangement can lead to a satisfactory solution. (Author)

A74-40000 # **The design and development of an advanced annular combustor for civil application.** A. B. Wassell and J. E. Bradley (Rolls-Royce /1971/, Ltd., Derby, England). In: International Symposium on Air Breathing Engines. 2nd, Sheffield, England, March 24-29, 1974, Proceedings.
London, Royal Aeronautical Society, 1974. 13 p. 6 refs.

One of the requirements of the RB.211 program from its inception was to produce a short overall engine length. This was, in turn, reflected in all the components including the combustor and led to ambitious performance targets being set in relation to the length made available for the combustion process. In order to meet these targets, several novel features were built into the combustor during its design and initial development phase, especially in the areas of the fuel injection system and liner cooling techniques. The development of new measuring techniques to assess achieved performance constituted a significant part of the total program. Nevertheless, the effort expended in the solution of these problems has enabled a much greater understanding of the whole combustion process to be achieved. A review of these new features and techniques is given, and their effectiveness is discussed. (Author)

A74-40001 # **Pyrogenic ignition system for afterburners.** S. Subrahmanyam, G. K. Murthy, and P. A. Paranjpe (National Aeronautical Laboratory, Bangalore, India). In: International Symposium on Air Breathing Engines, 2nd, Sheffield, England, March 24-29, 1974, Proceedings. London, Royal Aeronautical Society, 1974. 10 p. 6 refs.

Experiments show that a pyrogenic ignition system with hydrazine sprayed onto a rusted iron plate is very effective in producing a uniform ignition effect throughout an air-fuel mixture at a temperature as low as 400 C, with a possible ignition threshold at a temperature still lower, corresponding to that of a catalytic ignition system. The pyrogenic ignition system is more attractive than a catalytic ignition system in that it does not require an expensive catalyst and is not affected by soot or carbon deposition. V.Z.

A74-40002 # **Designing transonic turbine blades by the hodograph method (Trace des aubages de turbine transsoniques par la méthode de l'hodographe).** G. Karadimas (SNECMA, Paris, France). In: International Symposium on Air Breathing Engines, 2nd, Sheffield, England, March 24-29, 1974, Proceedings. London, Royal Aeronautical Society, 1974. 15 p. 8 refs.

Description of a method of increasing the work output of a transonic turbine stage without exceeding the limiting inlet Mach number. The proposed method is based on an augmentation of the peripheral velocity of the turbine blades, while keeping the sensitivity of the blades to variation of the operating conditions analogous to that of subsonic cascades. To resolve this problem, a method of uncoupled solution is employed which, by means of certain hypotheses, makes it possible to first solve a well-posed Dirichlet problem in the subsonic region and then solve a Cauchy problem to determine the supersonic zone. A.B.K.

A74-40008 # **The design and development of the Gem engine.** R. M. Heathcote and C. E. Payne (Rolls-Royce /1971/, Ltd., Watford, Herts., England). In: International Symposium on Air Breathing Engines. 2nd, Sheffield, England, March 24-29, 1974, Proceedings. London, Royal Aeronautical Society, 1974. 16 p.

The RS 360 or Gem engine was partly developed in connection with the Anglo-French helicopter agreement of 1967. The Gem engine is used to power the Westland Lynx helicopter. The Gem engine comprises a two-spool gas generator and a two-stage free power turbine with a through shaft. A shaft output speed of 6000

rpm is provided. General mechanical and installation features of the engine are discussed along with a number of development problems. Attention is given to the main reduction gear box, compressor design, the combustion system, the turbines, the oil system, and the air system. G.R.

A74-40087 * # **A review of air transport noise.** H. H. Hubbard and D. J. Maglieri (NASA, Langley Research Center, Acoustics and Noise Reduction Div., Hampton, Va.). In: Symposium on Noise in Transportation, Southampton, England, July 22, 23, 1974, Proceedings. Southampton, University of Southampton, 1974. 12 p. 9 refs.

Flight vehicles are characterized according to their manner of operation and type of propulsion system, and their associated sources of noise are identified. Available noise reduction technology as it relates to engine cycle design and to power plant component design is summarized. Such components as exhaust jets, fans, propellers, rotors, airflow-surface interactions, and reciprocating engine exhausts are discussed, along with their noise reduction potentials. Significant aircraft noise reductions are noted to have been accomplished by the application of available technology in support of noise certification rules. Improved analytical prediction methods, and well controlled validation experiments supported by advanced design aeroacoustic facilities, are required as a basis for an effective integrated systems approach to aircraft noise control. (Author)

A74-40089 # **Noise sources and their control in V/STOL aircraft.** I. C. Cheeseman. In: Symposium on Noise in Transportation, Southampton, England, July 22, 23, 1974, Proceedings. Southampton, University of Southampton, 1974. 11 p. 20 refs.

Review of the noise sources and noise generation mechanisms characterizing various kinds of lift systems used in V/STOL aircraft. In particular, the rotation- and vortex-induced noise generation of open and shrouded rotors is considered, along with some of the noise reduction means available. M.V.E.

A74-40090 # **Noise of advanced subsonic air transport systems.** D. G. Brown and A. A. Blythe (Hawker Siddeley Aviation, Ltd., Hatfield, Herts., England). In: Symposium on Noise in Transportation, Southampton, England, July 22, 23, 1974, Proceedings. Southampton, University of Southampton, 1974. 19 p. 13 refs.

Noise sources in advanced subsonic air transport systems are defined, and means for reducing the terminal noise of such systems are examined. Also, future noise targets and permissible community noise levels are reviewed. The penalties and economics of aircraft noise control are discussed. M.V.E.

A74-40092 # **Helicopter noise - Can it be adequately rated.** J. W. Leverton (Westland Helicopters, Ltd., Yeovil, Somerset, England). In: Symposium on Noise in Transportation, Southampton, England, July 22, 23, 1974, Proceedings. Southampton, University of Southampton, 1974. 12 p.

It is shown that current aircraft noise rating methods are not well suited for helicopter noise evaluations and that a new approach is required. Present uncertainties about such a new approach are discussed, and some of the research necessary for dispelling these uncertainties is outlined. M.V.E.

A74-40303 # **Crossflow-induced flow distortion and its influence on the performance of a vertical axis lifting fan.** U. W. Schaub. Ottawa, Carleton University, Faculty of Engineering, Doctor of Philosophy in Mechanical Engineering Thesis, 1973. 264 p. 80 refs. (ME-73-4)

The present work represents a detailed analytical investigation of the problem of the large crossflow distortions associated with the transition maneuvers of VTOL lifting fans from fan-supported to wing-supported flight. An analytical model is described representing the fan and the basic crossflow distortion mechanisms. The model comprises a segmented fan with simulated inflow and outlet distortions. The calculated flow distortions and fan performance are compared with corresponding experimental measurements involving a 12-inch diameter fan-in-wing model, and reasonable agreement has been achieved. P.T.H.

A74-40329 # **Airbus A-300 B (Airbus A-300 B).** *Technisch-ökonomische Informationen der zivilen Luftfahrt,* vol. 9, no. 2, 1973, p. 80-87. In German.

The increase in the number of passengers in short-haul and medium-range air traffic provided the incentive for the international aerospace industry to develop an airliner which can carry more than 200 passengers. The development of this aircraft, the Airbus A-300 B, was undertaken jointly by aerospace companies in West Germany, France, the UK, and the Netherlands. Questions of fuselage design are considered along with details regarding the wing assembly, the control surfaces, the landing gear, the propulsion system, the hydraulic system, the airconditioning system, the fuel system, and the power system. The approaches selected to ensure the cost-efficient performance of the various operations connected with the loading of the aircraft are also discussed. G.R.

A74-40406 # **Vibrations and stability of a helicopter with a two-blade main rotor (Kolebaniia i ustoichivost' vertoleta s dvukhlopastnym nesushchim vintom).** A. A. Shcherbina (Kievskii Institut Inzhenerov Grazhdanskoi Aviatsii, Kiev, Ukrainian SSR). *Prikladnaia Mekhanika,* vol. 10, June 1974, p. 56-60. In Russian.

Equations of motion are derived to describe the dynamic behavior of a helicopter with a two-blade main rotor on the ground. The equations include terms representing banking, pitching, damping, and resonance effects. Various resonance situations are considered. Conditions for resonance vibration damping are defined. Stability of a trivial solution to a system of resonance equations is examined. It is shown that the specific vibratory characteristics of a two-blade helicopter rotor can be studied by nonlinear mechanics methods regardless of ground resonance effects. V.Z.

A74-40502 * **Impact testing on composite fan blades.** R. H. Johns (NASA, Lewis Research Center, Materials and Structures Div., Cleveland, Ohio). *SAMPE Quarterly,* vol. 5, July 1974, p. 14-21.

The results of impact tests on large, fiber composite fan blades for aircraft turbofan engine applications are discussed. Solid composite blades of two different sizes and designs were tested. Both graphite/epoxy and boron/epoxy were evaluated. In addition, a spar-shell blade design was tested that had a boron/epoxy shell bonded to a titanium spar. All blades were tested one at a time in a rotating arm rig to simulate engine operating conditions. Impacting media included small gravel, two inch diameter ice balls, gelatin and RTV foam-simulated birds, as well as starlings and pigeons. The results showed little difference in performance between the graphite and boron/epoxy blades. The results also indicate that composite blades may be able to tolerate ice ball and small bird impacts but need improvement to tolerate birds in the small duck and larger category. (Author)

A74-40505 **'Kevlar' 49 woven and nonwoven fabric composites performance and applications.** D. L. G. Sturgeon, D. G. Wagle, and R. A. Wolffe (Du Pont de Nemours and Co., Inc., Wilmington, Del.). *SAMPE Quarterly,* vol. 5, July 1974, p. 31-36. 7 refs.

A74-40511 # **VFW 614 - An appraisal of Germany's new short haul jet.** N. Williams. *Shell Aviation News,* no. 423, 1974, p. 18-25.

The basic flight characteristics of the VFW 614, a new short haul jet aircraft, are described, and a performance evaluation flight is reported. This includes a description of start-up and taxi, take-off, altitude flight, trim system restraint, descent and low-speed maneuvers, stalling, pitch characteristics, and landing. The aircraft

features short take-off and landing capability from semi-prepared airfields, low turnround times, a high utilization rate, and a very low break-even factor on routes in excess of 100 km. P.T.H.

A74-40622 **Simulated aircraft accident exercises.** J. X. Stefanki. *SAFE Journal,* vol. 4, Fall 1974, p. 10-15.

The lessons learned in a number of full-scale simulated aircraft disaster drills are considered. Difficulties which should be taken into account in planning for an emergency are related to aspects of command in a disaster operation, questions of communication, and problems of coordination. It is recommended that all air carrier airports should be required to hold full-scale annual aircraft disaster drills. Each airport should have a designated Chief Medical Officer and participate in aircraft disaster planning. G.R.

A74-40647 **New heavy-haul freight aviation (Une nouvelle aviation de transport lourd).** J. Bertin (Société Bertin et Cie., Plaisir, Yvelines, France). *L'Aéronautique et l'Astronautique,* no. 46, 1974, p. 2-8. In French.

Air Freight today is taken care of with aircraft whose performances are designed to suit passenger transport. Speed increase has led to fly non stop at high altitude, and thus to carry a fuel load higher than the actual payload. For freight however aircraft flying at 200 Knots would be perfectly adapted; they could then fly at low altitude, stop on the way and carry a payload much more important than their fuel capacity. To be economical such aircraft must be large (1000 ton or more) and air cushion landing will become a necessity. Numerous tests effectuated on the Bertin air cushion landing for air-drop platform have been most encouraging. To transpose this technique to aircraft landing is very straight forward. (Author)

A74-40767 # **The heat-resistant deformable aluminum alloy D21 (Zharoprochnyi deformiruemyi aliuminievyi splav D21).** O. A. Romanova. *Metallovedenie i Termicheskaia Obrabotka Metallov,* no. 6, 1974, p. 9-13. In Russian.

The mechanical properties of an aircraft alloy were studied as a function of the magnesium, silicon, iron, and zinc content, keeping the content of the remaining alloying elements constant (6.2% Cu, 0.62% Mn, 0.13% Ti). Rod samples measuring 10 mm in diameter were quenched in water from 525 C and were subjected to aging at 190 C for 12 hr. Alloys with 0.3 to 0.45% Mg, heated for 1000 hr at 150 and 175 C, were found to have excellent creep-resistance, strength, and fatigue characteristics at 20 C. The strength characteristics are further improved by 0.1 to 0.3% Si additions. The iron content should not exceed 0.3% and the zinc content should not exceed 0.6%. The test results obtained with sheet and sectional samples are given in graphical form, and are compared with the AK4-1 alloy. V.P.

A74-40953 **Turbofan of the future.** C. E. Wise. *Machine Design,* vol. 46, Aug. 22, 1974, p. 20, 21, 23-25.

The QCSEE (Quiet, Clean, Short-haul Experimental Engine, or 'quixie') is an advanced turbofan engine designed for use on STOL aircraft destined primarily for operation over densely populated metropolitan areas. Incorporating performance and structural characteristics unlike those in any engine operating today, QCSEE will pioneer with an extremely high bypass ratio, reversible-pitch fan blades, a geared turbine/fan, digital electronic (fly-by-wire) engine controls, and extensive use of composites. The high-bypass design permits reduced airflow velocity, which results in reduced engine noise. QCSEE designers opted for a gearbox over additional turbine stages required for an engine of QCSEE's thrust rating. The gearbox incorporates a single-stage, six-star, epicyclic gear train. The variable-pitch fan will eliminate the need for add-on thrust reversers and enhance pilot control in the critical landing and takeoff portions of the flight profile. Military prototypes using the QCSEE are expected to fly in the 1975-1977 time frame. P.T.H.

STAR ENTRIES

N74-29367*# National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.
EFFECT OF SPANWISE BLOWING ON LEADING-EDGE VORTEX BURSTING OF A HIGHLY SWEPT ASPECT RATIO 1.18 DELTA WING
Wayne L. Scantling and Blair B. Gloss 15 Jul. 1974 30 p refs
(NASA-TM-X-71987) Avail: NTIS HC $3.25 CSCL 01A

An investigation was conducted in the Langley 1/8-scale V/STOL model tunnel on a semispan delta wing with a leading-edge sweep of 74 deg, to determine the effectiveness of various locations of upper surface and reflection plane blowing on leading-edge vortex bursting. Constant area nozzles were located on the wing upper surface along a ray swept 79 deg, which was beneath the leading-edge vortex core. The bursting and reformation of the leading-edge vortex was viewed by injecting helium into the vortex core, and employing a schlieren system.
Author

N74-29368# Sydney Univ. (Australia). Dept. of Aeronautical Engineering.
THREE COMPUTER PROGRAMMES TO CALCULATE THE STEADY OR UNSTEADY SUBSONIC CHARACTERISTICS OF LIFTING SURFACES IN GROUND EFFECT
G. H. S. Pike Jan. 1974 78 p refs
(ATN-7401) Avail: NTIS HC $7.00

Computer programs to calculate the subsonic, unsteady, and steady aerodynamic properties of lifting surfaces are presented. The programs are written in FORTRAN in two cases and BASIC in one case. The thin wing kernel function approach is used. Evidence is presented of the extreme sensitivity of the method to the size of the strip isolating the singularity. Banked and nonplanar wings, ground effect, and symmetrical, asymmetrical, and antisymmetrical loading are accounted for. A listing of the computer programs is provided.
Author

N74-29370*# National Aeronautics and Space Administration. Flight Research Center, Edwards, Calif.
USE OF A PITOT-STATIC PROBE FOR DETERMINING WING SECTION DRAG IN FLIGHT AT MACH NUMBERS FROM 0.5 TO APPROXIMATELY 1.0
Lawrence C. Montoya, Merle A. Economu, and Ralph E. Cissell Jul. 1974 22 p refs
(NASA-TM-X-56025; H-844) Avail: NTIS HC $3.00 CSCL 01A

The use of a pitot-static probe to determine wing section drag at speeds from Mach 0.5 to approximately 1.0 was evaluated in flight. The probe unit is described and operational problems are discussed. Typical wake profiles and wing section drag coefficients are presented. The data indicate that the pitot-static probe gave reliable results up to speeds of approximately 1.0.
Author

N74-29371# Bell Helicopter Co., Fort Worth, Tex.
AN ANALYSIS OF FIXED WING-PROPROTOR INTERFERENCE FOR FOLDING PROPROTOR AIRCRAFT Technical Report, 1971 - 1973
Carl G. Matthys, Mukund M. Joglekar, and P. Y. Ksieh Mar. 1973 320 p refs
(Contract F33615-70-C-1133; AF Proj. 8219)
(AD-778823; AFFDL-TR-72-115) Avail: NTIS CSCL 01/1

The report describes the development and implementation of an analysis of the mutual aerodynamic interference of the wing and the proprotor on a folding proprotor aircraft. The analysis was developed to complement and expand the capabilities of an existing AFFDL stability and control prediction method for helicopters and stoppable rotor aircraft. The wing-rotor interference section was added to the AFFDL program as an option to the user. This report is divided into four parts. The first part describes the formulation of a math model and its capabilities. The flight mode response of a typical folding proprotor aircraft during rotor feathering is discussed. The second part explains usage of a computer program implementing the math mode. Sample cases are presented as well as a description of the input and output formats. The third part contains a cross reference index of FORTRAN variables and subroutine names. The fourth part is a complete FORTRAN listing of the AFFDL program modified to include the interference subroutine.
Author (GRA)

N74-29372# Texas Univ., Austin. Dept. of Aerospace Engineering and Engineering Sciences.
SUPPRESSION OF FLUTTER ON INTERFERING LIFTING SURFACES BY THE USE OF ACTIVE CONTROLS Scientific Report
Emil Ernest Cwach and Ronald Oran Stearman Jan. 1974 174 p refs
(Grant AF-AFOSR-1998-71; AF Proj. 9782)
(AD-779770; AFOSR-74-0787TR) Avail: NTIS CSCL 01/1

An investigation into the possible increase in flutter speed of interfering lifting surfaces by the use of active controls was conducted. The study was designed so that the methods developed to determine the maximum increase in flutter speed could be applied to complex air vehicle configurations throughout the Mach number/altitude range of modern aircraft. The unsteady aerodynamic forces on the lifting surfaces were computed by using doublet lattice aerodynamic computer programs. The structural features of the lifting surfaces were represented by either experimentally measured or analytically computed vibration frequencies and mode shapes. The results of the study indicated that the use of active controls to suppress flutter on interfering lifting surfaces can be more effective than suppressing flutter on isolated surfaces.
Author (GRA)

N74-29374*# Boeing Commerical Airplane Co., Renton, Wash.
BRAKE CONTROL SYSTEM MODIFICATION, AUGMENTOR WING JET STOL RESEARCH AIRPLANE (AWJSRA)
R. L. Amberg, J. A. Arline, and R. W. Jenny 24 Jun. 1974 78 p refs
(Contract NAS2-7641)
(NASA-CR-137530; D6-41898) Avail: NTIS HC $7.00 CSCL 01C

The braking system for a short takeoff aircraft is discussed and the deficiencies are described. The installation of a Boeing 727 aircraft brake system was made to correct the deficiencies. Tests of the modified system were conducted using an analog computer/hardware simulator. Actual performance tests were conducted and the characteristics of the system were satisfactory.
Author

N74-29375*# American Airlines, Inc., New York.
ASSESSMENT OF THE APPLICATION OF ADVANCED TECHNOLOGIES TO SUBSONIC CTOL TRANSPORT AIRCRAFT Final Report
J. D. Graef, G. P. Salles, and J. T. Verges Aug. 1974 128 p refs
(Contract NAS1-12148)
(NASA-CR-132481) Avail: NTIS HC $9.50 CSCL 01C

Design studies of the application of advanced technologies to future transport aircraft were conducted. These studies were reviewed from the perspective of an air carrier. A fundamental

study of the elements of airplane operating cost was performed, and the advanced technologies were ranked in order of potential profit impact. Recommendations for future study areas are given. Author

N74-29376# National Research Council of Canada, Ottawa (Ontario). Div. of Mechanical Engineering.
ACOUSTIC TESTS ON A FAN-IN-WING MODEL: EFFECTS OF AN EXTENDED INLET
G. Krishnappa Feb. 1974 58 p refs
(NRC-13898; LR-576) Avail: NTIS HC $6.00

The aerodynamic noise generated by the lifting fan in the fan-in-wing configuration of vertical takeoff aircraft is discussed. The effect of increasing the depth of the inlet on the noise characteristics of the fan at static and crossflow conditions is analyzed. The causes for aerodynamic noise under crossflow conditions are explained. The changes in noise tonal signature under crossflow conditions were investigated in a wind tunnel. Author

N74-29379*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
SUPPRESSOR NOZZLE AND AIRFRAME NOISE MEASUREMENTS DURING FLYOVER OF A MODIFIED F106B AIRCRAFT WITH UNDERWING NACELLES
Richard R. Burley 22 Nov. 1974 34 p refs Proposed for presentation at Winter Ann. Meeting of the Am. Soc. of Mech. Engr., New York, 17-22 Nov. 1974
(NASA-TM-X-71578; E-8028) Avail: NTIS HC $3.25 CSCL 23A

The effect of flight velocity on the jet noise and thrust of a 104-tube suppressor nozzle was investigated using an F-106B delta wing aircraft modified to carry two underwing nacelles each containing a turbojet engine. The nozzle was mounted behind one of the nacelles. Flight velocity had a large adverse effect on thrust and a small adverse effect on suppression when correlated with relative jet velocity. The clean airframe noise of the aircraft was measured at Mach 0.4 and was compared with that predicted from an empirical expression. The 83 db measured value was considerably below the predicted value. Author

N74-29382*# Lockheed-Georgia Co., Marietta.
STUDY OF STABILITY OF LARGE MANEUVERS OF AIRPLANES Final Report
Emile K. Haddad Washington NASA Aug. 1974 76 p refs (Contract NAS1-11667)
(NASA-CR-2447) Avail: NTIS HC $4.00 CSCL 01B

A predictive method of nonlinear system analysis is used to investigate airplane stability and dynamic response during rolling maneuvers. The maneuver roll-rate is not assumed to be constant, and the airplane motion is represented by a set of coupled nonlinear differential equations. The general rolling maneuver is kinematically specified by its roll-rate variation p(t). A method for relating the airplane dynamic response to p(t) is developed. The method provides analytical expressions for the motion variables in terms of the maneuver descriptor p(t). A parameterized family of rolling maneuvers is considered, for which the method is used to predict specific dynamic response information, such as the dependence of the peak angle-of-attack excursion on the maneuver parameters. The stability and motion of the airplane in response to an arbitrary actuation of aileron input is considered. Analytical expressions relating motion variables to aileron input are obtained. Explicit analytical bounds on the motion variables are derived. A stability criterion which guarantees nondivergence of motion in response to aileron actuation is presented. Author

N74-29389# Air Force Inst. of Tech., Wright-Patterson AFB, Ohio. School of Engineering.
APPLICATION OF SAMPLED-DATA CONTROL TECHNIQUES IN THE DESIGN OF AN AIRCRAFT FLUTTER MODE CONTROLLER M.S. Thesis
James P. Balma Mar. 1974 176 p refs
(AD-779078; GE/EE/74M-1) Avail: NTIS CSCL 01/2

The problem of designing a sampled-data flutter mode controller using optimal control techniques is investigated. The plane being controlled is the Control Configured Vehicle NB-52. The continuous equations of motion about the longitudinal aircraft axis are discretized by the state transition method. Using the discrete equations of motion the discrete linear regulator problem is solved. An acceptable set of quadratic weightings is developed for the full-state feedback problem. Full-state feedback is not physically realizable so it is necessary to solve the suboptimal problem. The infinite time discrete linear stochastic regulator problem is developed and solved. The radient derived in this development is used in a performance minimization by conjugate gradients algorithm to derive the best suboptimal feedback gains. A digital simulation is performed that demonstrates a successful design. Author (GRA)

N74-29390# Army Aviation Systems Command, St. Louis, Mo.
A COMPUTER MODEL FOR ECONOMIC ANALYSIS OF ARMY AIRCRAFT RAM IMPROVEMENT PROPOSALS Final Report
Tony Kassos Mar. 1974 97 p refs
(AD-778751; USAAVSCOM-TR-74-19) Avail: NTIS CSCL 01/3

The report has been prepared for presentation to the Joint AMC/TRADOC RAM Seminar scheduled for 4th Quarter, FY 1974, at Ft. Lee, Virginia. AR 702-3, Army Material Reliability, Availability, and Maintainability (RAM), 22 March 73 places increased emphasis on the cost impact of RAM efforts. This division was invited by the seminar sponsors to deliver a presentation on an economic analysis model developed here and to discuss how it could be applied to RAM cost studies. This report is in response to this request. A computer model is presented for preparing the cost trade off studies of RAM efforts required by AR 702-3. The model is specifically directed to RAM efforts involving Army aircraft. It determines the total life cycle cost impact of a RAM effort and pertinent RAM parameters. It is a modification of the economic analysis model mentioned above and is a preliminary effort to combine the methodologies of cost analysis and product assurance. Author (GRA)

N74-29392# Air Force Inst. of Tech., Wright-Patterson AFB, Ohio. School of Engineering.
DESIGN OF A CONTROL SYSTEM TO STABILIZE THE AFT FUSELAGE OF A B-52 BOMBER IN THE PRESENCE OF A RANDOM WIND GUST M.S. Thesis
Charles A. Harrington, III Mar. 1974 103 p refs
(AD-779081; GE/EE/74M-5) Avail: NTIS CSCL 01/2

A control system was designed to stabilize the flexible aft-body of a B-52 bomber, under the influence of a 1.0 ft/sec rms vertical wind gust. Optical instruments, mounted in the aft-body, can therefore be aimed more accurately, and with a less complex aiming device, because of the improvement in stability due to the control system. The aircraft transfer functions, which include the effects of the first seven bending modes, were obtained using digital computer programs provided by the Air Force Flight Dynamics Laboratory, Wright-Patterson Air Force Base, Ohio, and data and equations provided by the Boeing Aircraft Corporation. The open-loop pitch-rate and normal acceleration responses to the wind gust were determined using a digital computer program called MIMIC, which simulates the functions of an analog computer. The design procedure uses the principle of superposition to minimize the effects of a wind gust disturbance on the aircraft. (Modified author abstract) GRA

N74-29393# McDonnell-Douglas Corp., Long Beach, Calif.
WINDSHIELD BIRD STRIKE STRUCTURE DESIGN CRITERIA Final Report, 2 Oct. 1972 - 1 Aug. 1973
James H. Lawrence, Jr. and Murl J. Coker Oct. 1973 259 p refs
(Contract F33615-73-C-3030; AF Proj. 4363)
(AD-779729; AFFDL-TR-73-103) Avail: NTIS CSCL 01/2

The study determines the inadequacies of existing bird impact design criteria for windshield/canopies and support structure. Second, it establishes recommended design criteria for future aircraft, particularly those involved in high speed-low level training missions. The methods used in the study were primarily that of

collecting, examining, and selecting pertinent data from a multitude of sources on birds and their behavior aircraft/bird incidents, and aircraft design criteria. Procedures are proposed for USAF aircraft designed to inadequate or no bird-impact requirements. Of particular value are avoidance and alleviation techniques for reduction of the inviting bird environment surrounding airports, improved use of radar and other mechanical devices to predict/determine the presence of dangerous bird and/or flock sizes. Recommended design criteria for subsequent design of windshields/canopies and support structure are presented. (Modified author abstract) GRA

N74-29395# Lockheed-California Co., Burbank.
LOW NOISE PROPELLER TECHNOLOGY DEMONSTRATION Final Technical Report, 15 Feb. 1973 - Jan. 1974
Edward D. Griffith and James D. Revell Jan. 1974 202 p refs
(Contract F33615-73-C-2045; AF Proj. 3066)
(AD-779773; AFAPL-TR-73-115) Avail: NTIS CSCL 20/1

Quiet aircraft used for covert aerial night reconnaissance employ low tip speed propellers to achieve a minimum acoustic noise signature. This study was initiated when certain unexpected and anomalous trends in the measured propeller noise of such aircraft were compared to predictions of noise made by the Air Force Propeller Noise Prediction Program. Large discrepancies in both trends and levels were noted between measured and predicted noise. Therefore, the goal of this study was the modification of an existing Air Force computer program such that accurate predictions of far field noise for low tip speed propellers can be made. Empirical data from previous quiet airplane experiments were used to develop modifications to both rotational and vortex noise prediction methods for propellers operating in the tip speed range from Mach 0.2 to 0.4. (Modified author abstract) GRA

N74-29396# Boeing Aerospace Co., Seattle, Wash. Research and Engineering Div.
ADDITIONAL STUDIES, VARIABLE CAMBER WING, PHASE 1 Final Report, Jul. 1973 - Jan. 1974
Douglas Gould Feb. 1974 47 p refs
(Contract N00014-73-C-0244)
(AD-779041; D180-17606-2) Avail: NTIS CSCL 01/3

A smooth variable camber wing system using flexible skins has been designed for fighter and attack airplanes. Comparisons of this system with other systems such as leading edge slats, plain flaps, canards and the box wing illustrate its overall performance superiority. Estimates of the performance improvements which result when smooth curved variable camber flaps are applied to the F-8, F-4, A-7, F-14, and S-3 show that any of these aircraft could benefit from the addition of this system. Author (GRA)

N74-29401# Lockheed-California Co., Burbank.
ANALYSIS OF MANEUVERABILITY EFFECTS ON ROTOR/WING DESIGN CHARACTERISTICS Final Report, 1970
N. B. Gorenberg and W. P. Harvick Feb. 1974 263 p refs
(Contract DAAJ02-70-C-0032; DA Proj. 1X1-64206-D-378)
(AD-779448; LR-24051; USAAMROL-TR-74-24) Avail: NTIS CSCL 01/3

An analytical study was performed to contribute toward design criteria for the Utility Tactical Transport Aircraft System (UTTAS) through an analysis of maneuvers to determine effects of the maneuvers on helicopter design characteristics. Maneuverability requirements examined were combinations of maximum flight speeds and maneuvering load factors and sustained high load factors for long periods of time as might be expected in nap-of-the-earth flying. The study included analyses to examine the possibility of gaining maneuver capability at high speeds by adding wings to helicopters. Analysis of results showed no large difference between winged and nonwinged helicopters. Those differences that did emerge, however, were in favor of adding the wing. Whether or not these differences would become more significant through additional design iterations of a particular design is not yet clear. Author (GRA)

N74-29402# Lockheed-California Co., Burbank.
APPLICATION OF AN INTERDISCIPLINARY ROTARY WING AIRCRAFT ANALYSIS TO THE PREDICTION OF HELICOPTER MANEUVER LOADS Final Report, Jun. 1972 - Jun. 1973
William D. Anderson, Fox Conner, and Andrew W. Kerr Dec. 1973 420 p refs
(Contract DAAJ02-72-C-0100; DA Proj. 1F1-62208-AA-82)
(AD-779449; LR-25945; USAAMRDL-TR-73-83) Avail: NTIS CSCL 01/3

A complete understanding of the factors which establish the flight envelope of a helicopter requires simultaneous consideration of power, static and dynamic stability, handling qualities, and pilot techniques as well as resulting loads and vibration levels. To facilitate this understanding, an interdisciplinary mathematical model that provides analytical prediction of free-flight characteristics of single-rotor helicopter and compound helicopter configurations has been developed. The work described in this report presents a loads correlation of the current (REXOR II) program with existing AH-56A and XH-51A (compound) test data with primary focus on steady and cyclic loads during steady and transient maneuvers. GRA

N74-29616# Army Land Warfare Lab., Aberdeen Proving Ground, Md.
UH-1 GROUND HANDLING WHEEL ADAPTER BARS FOR OH-58 HELICOPTERS. PROTOTYPE DESIGN, FABRICATION, AND USER TEST Final Report
Joseph T. Gurganious Mar. 1974 42 p refs
(AD-778199; LWL-TR-74-27) Avail: NTIS CSCL 01/5

In response to the Army's need to move OH-58 helicopters over difficult terrain areas, USALWL devised and developed the UH-1 Ground Handling Wheel Adapter Bar System for OH-58 Helicopters. The system was feasibility tested by USAATB, Fort Rucker. It was user evaluated by MASSTER and 1st Cav. Div. at Fort Hood, and by 101st Airborne Div. at Fort Campbell. Conclusions indicate that the UH-1 Ground Handling Wheel Adapter Bar System can provide the Army with a safe, practical, and suitable means for ground handling the OH-58 helicopters over unprepared terrain. Author (GRA)

N74-29627# Army Land Warfare Lab., Aberdeen Proving Ground, Md.
DESIGN OF A POWERED WHEEL KIT FOR UH/AH HELICOPTERS Final Report
Charles R. Wilson Apr. 1974 20 p
(AD-779387; LWL-TR-74-39) Avail: NTIS CSCL 13/6

The powered wheel kit consists of the standard unpowered ground handling wheel set, which has been modified by application of a power package. Each wheel is driven by a two-cycle engine and hydraulic drive unit. The kit was designed and fabricated, but only brief functional check-out tests were conducted. The task has been reassigned to the Aviation Systems Command for further testing. (Modified author abstract) GRA

N74-29800* Kanner (Leo) Associates, Redwood City, Calif.
INVESTIGATION OF THE REACTIONS OF SKIN PANELS IN RELATION TO DURATION OF ACOUSTICAL LOADING c32
V. Ye. Kvitka and G. I. Kernes *In its* Cybernetic Diagnostics of Mech. Systems with Vibro-acoustic Phenomena (NASA-TT-F-14899) Jun. 1973 p 41-43 Transl. into ENGLISH from the book "Kiberneticheskaya Diagnostika Mekhanicheskikh Sistem po Vibroakusticheskim Protsessam" Kaunas, KPI Press, 1972 p 39-41
CSCL 20K

Certain characteristics of the reactions of typical skin panels of a passenger aircraft to acoustical loading are being investigated, for development of an objective method of diagnostics for skin condition, under the operations and maintenance sections of civil aviation. There are a number of difficulties connected with the solution of this problem. The reactions of skin panels exposed to the noises of the exhaust jets are dependent on the aircraft

operating conditions, the geometric parameters and limiting conditions of the panels. Author

N74-29875* Kanner (Leo) Associates, Redwood City, Calif.
INVESTIGATION OF THE POSSIBILITY OF USE OF VIBROACOUSTICAL SIGNALS FOR PURPOSES OF DIAGNOSTICS IN AERONAUTICAL ENGINEERING c28
A. R. Press *In its* Cybernetic Diagnostics of Mech. Systems with Vibro-acoustic Phenomena (NASA-TT-F-14899) Jun. 1973 p 317-319 Transl. into ENGLISH from the book "Kiberneticheskaya Diagnostika Mekhanicheskikh Sistem po Vibroakusticheskim Protsessam" Kaunas, KPI Press, 1972 p 284-285

CSCL 21A

The application of vibroacoustic techniques for diagnosing aircraft engine malfunctions is discussed. An experiment was conducted to determine the defects introduced by the nature of change in the amplitude-frequency characteristics of the noises and vibrations of an aircraft jet engine. The manner in which the defects were simulated is explained. The test equipment used during the experiment is identified. The results of the amplitude-frequency characteristics investigation are summarized to show optimum location of the microphone pick-up to record the acoustic data. Author

N74-30013# LTV Aerospace Corp., Dallas, Tex. Vought Systems Div.
S-3A GRAPHITE/EPOXY SPOILER DEVELOPMENT PROGRAM Interim Technical Report, 29 Jun. - 31 Dec. 1973
Jan. 1974 166 p
(Contract N62269-73-C-0610)
(AD-779069; Rept-2-53443/3R-3139; ITR-1) Avail: NTIS CSCL 11/4

Material selection, structural analysis, manufacturing and tool development and verification testing results are presented for an S-3A graphite spoiler. The spoiler is designed to be a cost competitive lightweight replacement for the metal spoiler, and is to be fit and functionally interchangeable with the existing part. The spoiler will be of sandwich construction with graphite/epoxy faces and non-metallic core. Narmco 5209/T300 graphite/epoxy tape material which has a 260F curing temperature was selected for the skins and fiberglass (HRP) core will be used. Problems encountered during the fabrication of 12 manufacturing development specimens and 118 design verification specimens are outlined and solutions explained. A manufacturing operational sequence describes the major fabrication operations. Design verification testing resulted in a design modification to the spoiler because of loss of strength and stiffness when the sandwich specimens were co-cured. Detail assembly drawings are included. GRA

N74-30093*# Aerospace Systems, Inc., Burlington, Mass.
NAVIGATION AND GUIDANCE REQUIREMENTS FOR COMMERCIAL VTOL OPERATIONS Interim Technical Report
William C. Hoffman, Walter M. Hollister, and Jack D. Howell
Jan. 1974 252 p refs
(Contract NAS1-12199)
(NASA-CR-132423; ASI-TR-74-17) Avail: NTIS HC $15.75 CSCL 17G

The NASA Langley Research Center (LaRC) has undertaken a research program to develop the navigation, guidance, control, and flight management technology base needed by Government and industry in establishing systems design concepts and operating procedures for VTOL short-haul transportation systems in the 1980s time period. The VALT (VTOL Automatic Landing Technology) Program encompasses the investigation of operating systems and piloting techniques associated with VTOL operations under all-weather conditions from downtown vertiports; the definition of terminal air traffic and airspace requirements; and the development of avionics including navigation, guidance, controls, and displays for automated takeoff, cruise, and landing operations. The program includes requirements analyses, design studies, systems development, ground simulation, and flight validation efforts. Author

N74-30095*# National Aeronautics and Space Administration, Ames Research Center, Moffett Field, Calif.
A STOL TERMINAL AREA NAVIGATION SYSTEM
Frank Neuman and David N. Warner, Jr. May 1974 69 p refs
(NASA-TM-X-62348) Avail: NTIS HC $6.50 CSCL 17G

The mechanization and performance of a STOL terminal area navigation system are described. The purpose of the navigation system is to allow flying with precision 4D-guidance along complex flight paths in the terminal area, and to develop requirements for STOL operations in the 1980s. The navigation aids include an experimental microwave landing system, MODILS. The systems description begins with the navigation aids. It is shown how the data are transformed and combined with other data to obtain position and velocity estimates. Also presented are some of the design changes and other features that were introduced as a result of flight testing. The various ways of displaying navigation-derived data are given. Finally, simulator and flight test results are discussed. Author

N74-30104# National Aviation Facilities Experimental Center, Atlantic City, N.J.
NATIONAL AIRSPACE SYSTEM ENROUTE STAGE A SYSTEM ENGINEERING AND ANALYSIS, INVESTIGATION OF SYSTEM PROBLEMS, CAPACITY TESTING Final Report, Aug. 1972 - Oct. 1973
Harry T. Morgan, Jr. Apr. 1974 27 p refs
(AD-778479; FAA-NA-73-109; FAA-RD-74-51) Avail: NTIS CSCL 17/7

A series of special engineering tests was designed to determine what, if any, capacity limitations would occur when NAS 3d1 was operated under steadily increasing traffic load. The tests were performed at the National Aviation Facility Experimental Center (NAFEC) employing the Digital Simulation Facility and the System Support Facility. Both the Display Channel Complex and the Computer Display Channel modes of operation were investigated. NAS 3d1 successfully met capacity test criteria. This report describes these tests and the results obtained.
Author (GRA)

N74-30239*# General Electric Co., Cincinnati, Ohio. Aircraft Engine Group.
CONCEPTUAL DESIGN STUDIES OF LIFT/CRUISE FANS FOR MILITARY TRANSPORTS Final Report
6 Aug. 1974 264 p refs
(Contract NAS3-17850)
(NASA-CR-134636; R74AEG283) Avail: NTIS HC$16.25 CSCL 21E

A study program for conceptual design studies of remote lift and lift/cruise fan systems to meet the requirements of military V/STOL aircraft was conducted. Parametric performance and design data are presented for fans covering a range of pressure ratios, including both single and two stage fan concepts. The gas generator selected for these fan systems was the J101-GE-100 engine. Noise generation and transient response were determined for selected fan systems. Author

N74-30240*# National Aeronautics and Space Administration, Lewis Research Center, Cleveland, Ohio.
NOISE GENERATED BY QUIET ENGINE FANS. 2: FAN A
Francis J. Montegani, John W. Schaefer, and Edward G. Stakolich
Washington Jul. 1974 74 p refs
(NASA-TM-X-3066; E-7857) Avail: NTIS HC $3.75 CSCL 21E

A significant effort within the NASA Quiet Engine Program has been devoted to acoustical evaluation at the Lewis Research Center noise test facility of a family of full-scale fans. This report, documents the noise results obtained with fan A - a 1.5-pressure-ratio, 1160-ft/sec-tip-speed fan. The fan is described and some aerodynamic operating data are given. Far-field noise around the fan was measured for a variety of configurations pertaining to acoustical treatment and over a range of operating conditions. Complete results of 1/3-octave band analysis of the data are presented in tabular form. Included also are power spectra and sideline perceived noise levels. Some representative 1/3-octave

band data are presented graphically, and sample graphs of continuous narrow-band spectra are also provided. Author

N74-30249*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
EFFECTS OF FORWARD VELOCITY AND ACOUSTIC TREATMENT ON INLET FAN NOISE
Charles E. Feiler and James E. Merriman (Douglas Aircraft, Co., Long Beach, Calif.) 1974 21 p refs Presented at the Sixth Aircraft Design Flight test and Operations Meeting, Los Angeles, 12-14 Aug. 1974; sponsored by the American Institute of Aeronautics and Astronautics
(NASA-TM-X-71591; E-8045) Avail: NTIS HC $3.00 CSCL 21E

Flyover and static noise data from several engines are presented that show inlet fan noise measured in flight can be lower than that projected from static tests for some engines. The differences between flight and static measurements appear greatest when the fan fundamental tone due to rotor-stator interaction or to the rotor alone field is below cutoff. Data from engine and fan tests involving inlet treatment on the walls only are presented that show the attenuation from this treatment is substantially larger than expected from previous theories or flow duct experience. Data showing noise shielding effects due to the location of the engine on the airplane are also presented. These observations suggest that multiringed inlets may not be necessary to achieve the desired noise reduction in many applications. Author

N74-30414*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.
SINGLE WING SUPERSONIC AIRCRAFT Patent Application
Robert T. Jones, inventor (to NASA) Filed 12 Aug. 1974 40 p
(NASA-Case-ARC-10470-3; US-Patent-Appl-SN-496779) Avail: NTIS HC $5.00 CSCL 01C

An aircraft is described, having a single fuselage with a main wing and a horizontal stabilizer airfoil pivotally attached at their centers to the fuselage. The pivotal attachments allow the airfoils to be yawed relative to the fuselage for high speed flight, and to be positioned at right angles with respect to the fuselage during takeoff, landing, and low speed flight. The main wing and the horizontal stabilizer are upwardly curved from their center pivotal connections towards their ends to form curvilinear dihedrals. NASA

N74-30421* National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.
DEPLOYABLE FLEXIBLE VENTRAL FINS FOR USE AS AN EMERGENCY SPIN RECOVERY DEVICE IN AIRCRAFT Patent
Sanger M. Burk, Jr., inventor (to NASA) Issued 30 Jul. 1974 13 p Filed 14 Sep. 1972 Supersedes N73-10031 (11 01, p 0004)
(NASA-Case-LAR-10753-1; US-Patent-3,826,448; US-Patent-Appl-SN-289018; US-Patent-Class-244-91; US-Patent-Class-244-327; US-Patent-Class-244-90R) Avail: US Patent Office CSCL 01B

A flexible fin device for mounting on an aircraft to effect spin recovery is described. The device may be selectively deployed to provide a triangular planform of flexible material to provide spin recovery, and retracted for compact storage during non-use. A single flexible fin may be deflected in a specific direction depending on direction of spin rotation, or two flexible fins forming an inverted V configuration may be used. The device is mounted on the underbody of the aircraft.
Official Gazette of the U.S. Patent Office

N74-30425*# Scientific Translation Service, Santa Barbara, Calif.
COMPARISON OF THE INFLUENCE OF HORIZONTAL AND VERTICAL GUST INTERFERENCES ON AIRCRAFT LONGITUDINAL MOTION
G. Schaenzer Washington NASA Jul. 1974 7 p Transl. into ENGLISH from the German report DLR-Mitt-70-12 Presented at the meeting of the DGLR Sci. Comm. on Flight Performance and Flight Characteristics, Darmstadt, 12-13 Nov. 1970
(Contract NASw-2483)
(NASA-TT-F-15801; DLR-Mitt-70-12) Avail: NTIS HC $4.00 CSCL 01B

In determining the influence of gust loads on a noncontrolled longitudinal aircraft motion, it is shown to be necessary to take into account horizontal and vertical gust components, their frequencies and power spectra. The gust disturbances can be divided into two typical frequency regions, independent of the reaction of the aircraft, which lie approximately above and below the eigen frequency of the fast angle of attack oscillation. At the higher gust frequencies, the vertical gusts dominate, especially at altitudes above 500 meters. At altitudes below 50 meters, the horizontal gusts have the greatest influence in both frequency regions. Author

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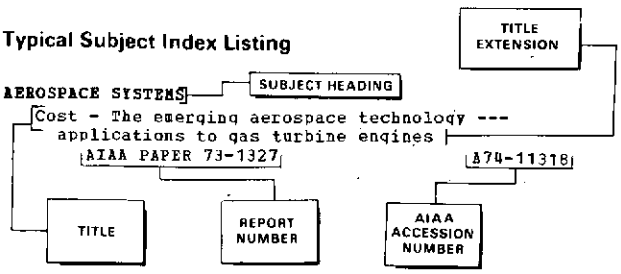

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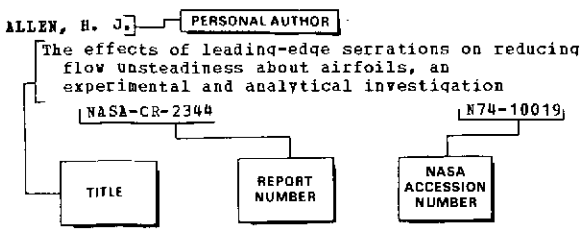

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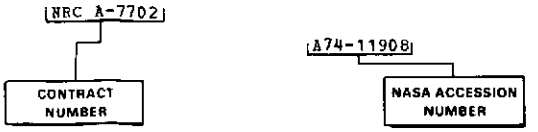

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